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The Engineer.

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VOL. CXLIII.—No. 3712] LONDON: FRIDAY EVENING, MARCH 4, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. About 130 TONS of STEEL BOLTS and NUTS, &c., for CROSSINGS.
2. ONE WHEEL LATHE, capable of Turning Motor Bogie Wheels 43in. diameter, motor driven.

Tenders due on the 14th March, 1927, for No. 1, and on the 15th March, 1927, for No. 2.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 4903

Assistant Civil Engineers REQUIRED in Civil Engineer-in-Chief's Department, Admiralty, and H.M. Naval Establishments at home and abroad. Candidates must be between the ages of twenty-five and thirty years on the 16th March, 1927; those who have served or are serving in the Army, Navy or Air Force may deduct from their actual age any time, not exceeding three years, during which they have so served. Candidates must either (a) be Corporate Members of the Institution of Civil Engineers, or (b) have passed Sections A and B of the Associate Membership Examination of the Institution of Civil Engineers or taken a Degree recognised by the Institution as exempting therefrom, and have reached such a stage in their professional training that it is possible for them to become Corporate Members within two years.
Those appointed will be on probation for two years, and will not be confirmed unless and until they, being Corporate Members of the Institution of Civil Engineers, have passed this period of probation to the satisfaction of the Admiralty.
Commencing salary, £250 per annum, plus Civil Service bonus, which at the current rate amounts to £111 per annum.
Special consideration will be given to candidates who served in H.M. Forces during the War.
No candidate will be accepted for appointment who fails to pass a strict medical examination as to his physical fitness.
Forms of application, &c., can be obtained from the CIVIL ENGINEER-IN-CHIEF, Admiralty, London, S.W. 1, and should be returned completed so as to reach that officer not later than the 16th March, 1927.
Candidates will be responsible for any expenses which they may incur in attending for interview. 4806

Assistant Engineer Required QUIRED by the GOVERNMENT of KENYA COLONY for service in connection with the Mombasa Town Planning Scheme, for a tour of from 20 to 30 months' service, with possible extension. Salary £650 a year. Free quarters and passages and liberal leave on full salary. Candidates, aged 30 to 38, must be A.M.I.C.E. or hold equivalent professional qualifications and have had thorough experience of municipal engineering and macadam roads.—Apply at once by letter, stating age, qualifications, and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15029. 4925

Civil Engineer Required for the NIGERIAN RAILWAY (Capital Works), for two tours of 12 to 18 months' service, with possible extension. Salary £480, rising to £920 a year. Free quarters and passages and liberal leave on full salary. Outfit allowance of £60 on first appointment. Candidates, age 25-35, should have had Constructional experience on recognised railways in the United Kingdom or abroad. Preference will be given to man with a knowledge of track work, bridges and culverts. It is desirable they should have passed the examination to qualify for A.M.I.C.E. or hold equivalent qualifications.—Apply at once by letter, stating age, qualifications, and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14996. 4899

Assistant Engineers (4) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which, subject to satisfactory service, the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no absolute guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 28, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers and possess a civil engineering degree or obtained such other diplomas or distinction in engineering as the Secretary of State may decide in any particular case or have completed ies with a civil engineer of good standing, at ave passed the examination for Associate Membe. of the Institution of Civil Engineers. In additicu, candidates must have had at least one year's practical experience of civil engineering under a qualified engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15224. 4916

Wanted at Once, Temporary CIVIL ENGINEERING ASSISTANTS for London Office. Only men with sound theoretical training and recent actual experience in Design Work for Heavy Dock Engineering and Reinforced Concrete Work required.
Preference given to ex-Service men.
Apply, giving full particulars of experience, age, salary required, when disengaged, and enclosing copy of recent testimonials, to CIVIL ENGINEERING-CHIEF, Admiralty, S.W. 1. 4818

The Engineer

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PUBLIC NOTICES

Mechanical and Electrical DRAUGHTSMAN REQUIRED by Air Ministry, W. and B. Department, Egypt. Salary £140-7s-£200 a year plus Civil Service Bonus (equivalent £220-£299 a year), with Foreign Service Allowance £300 a year (married), £200 a year (unmarried). Qualifications three years' practical experience in an engineering works, good theoretical knowledge and ability to prepare lay-out drawings of electrical installations, water supply systems and general mechanical and electrical engineering details.
Preference to ex-Service men.
Apply, AIR MINISTRY, W.B., 5, Adastral House, W.C. 2, submitting sample drawings. 4875

Royal Navy. WANTED FOR CONTINUOUS SERVICE.
FITTERS AND TURNERS OR INSTRUMENT MAKERS
for the rating of
ELECTRICAL ARTIFICER (Rank PETTY OFFICER).
Age 21 to 28. Engagement for 12 years.
Pay 56s. to 70s. a week and free rations, rising to 80s. 6d. per week for Chief Electrical Artificer (1st Class). A free kit is provided on entry, and kit upkeep allowance thereafter. Marriage allowance to men over 25 years.
Application should be made to the DEPARTMENT OF NAVAL RECRUITING, 55, Whitehall, London, S.W. 1, or to any Naval Recruiting Office. 4876

The Department of SCIENTIFIC AND INDUSTRIAL RESEARCH is considering the appointment of a DIRECTOR OF RESEARCH INTO THE PREVENTION OF WATER POLLUTION AND COGNATE PROBLEMS. Salary will be of the order of £1200 per annum, according to qualifications.
Forms of application and further particulars may be obtained from the Secretary of the Department, 16, Old Queen-street, S.W. 1. Applications should reach the Department not later than March 31st. 4883

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 AND 1919.

Notice is Hereby Given that IDEAL ROLLER and MANUFACTURING COMPANY, a corporation duly organised and existing under the laws of the State of Illinois, United States of America, and having a place of business at No. 2512, West 24th-street, Chicago, State of Illinois, United States of America, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 111,868 granted to Lewis William Goold for an invention entitled "Improvements in the Art of Making Rollers."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 23rd February, 1927.
Any person, or persons, may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. S. JARRATT,
4909 Comptroller-General.

1926. M. No. 3039.

In the High Court of Justice,
Chancery Division,
Mr. Justice Tomlin.
IN THE MATTER of LETTERS PATENT Granted to JOSEPH LESLIE MUSGRAVE and RICHARD CRITTALL and COMPANY Limited bearing date the 11th May 1911 and numbered 11,396 of 1911 for the Invention of an Improved Method or Installation for Heating and Cooling Buildings;
and
IN THE MATTER of the PATENTS AND DESIGNS ACTS, 1907 and 1919.

Notice is Hereby Given that Joseph Leslie Musgrave of 43, Bloomsbury-square in the County of London Richard Crittall and Company Limited whose registered office is situate at 43, Bloomsbury-square in the County of London and J. Jeffreys and Co. Limited whose registered office is situate at Barrons-place, Waterloo-road in the County of London have by Originating Summons dated the 9th October 1926 applied that the term of the above mentioned Patent be extended AND NOTICE IS HEREBY GIVEN that on Tuesday the 5th April 1927 Application will be made to the Court that a day may be fixed before which the said Summons shall not be in the paper for Hearing AND NOTICE IS HEREBY GIVEN that any person desirous of being heard in opposition to the said Summons must at least seven days before the said 5th April 1927 lodge Notice of such Opposition at the Chambers of Mr. Justice Tomlin, Room 175, Royal Courts of Justice, Strand, London, and serve a copy thereof upon the above named Applicants.
Dated this 1st day of March 1927.
NICHOLLS and CO.,
17, Farringdon-street, London, E.C. 4,
Solicitors for the Applicants upon whom all documents requiring service should be served. 4927

PUBLIC NOTICES

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, LONDON, E.C. 1
(Convenient to Angel (Tube) and Farringdon-street Stations).
A COURSE OF FOUR LECTURES on "POWER STATION CHEMISTRY" will be given by Mr. W. S. PATTERSON, M.Sc., on successive Friday evenings, commencing on FRIDAY, MARCH 18th, 1927, at 7.15 p.m.
SYLLABUS :—Coal, sampling and testing, calorific value, flue gas analysis interpretation and relation to heat balance sheet. Boiler feed water and boiler corrosion. Lubricating oils, methods of examination and properties.
Admission free, without ticket.
S. C. LAWS, M.A., M.Sc.,
4928 Principal.

Borough of Guildford. WATERWORKS EXTENSIONS UNDER GUILDFORD CORPORATION ACT, 1926.
CONTRACT NO. 2.
REINFORCED CONCRETE RESERVOIRS ON PEWLEY HILL AND HOG'S BACK.
The Corporation of Guildford are open to receive TENDERS from well-established Contractors experienced in carrying out reinforced concrete waterworks for the CONSTRUCTION of a ONE MILLION-GALLON SERVICE RESERVOIR on Pewley Hill; a HALF MILLION-GALLON SERVICE RESERVOIR on the Hog's Back; and a 6in. CAST IRON PIPE LINE, about a mile long, also on the Hog's Back. The contractors will be allowed to sublet the pipe line under certain conditions.
Copies of the form of contract, general conditions, specification, bill of quantities and drawings will be issued to a limited number of selected firms on March 9th, 1927, and Tenders must be submitted on or before Monday, March 21st, 1927.
Contractors willing to Tender are requested to write to that effect to the Consulting Engineer, Mr. Percy Griffith, M.I.C.E., F.G.S., 99, Victoria-street, Westminster, S.W. 1.
C. H. WOOD,
Town Clerk.
Town Clerk's Office, Guildford,
February 28th, 1927. 4869

City of Hull. TO ENGINEERS AND OTHERS.
PUMPING MACHINERY—HALL-ROAD.
The Corporation is prepared to receive TENDERS for PROVIDING and FIXING TWO 9in. VERTICAL SPINDLE CENTRIFUGAL SEWAGE PUMPS complete with A.C. MOTORS, SHAFTING, SWITCH-GEAR, PIPING, VALVES, &c.
Forms of Tender and other particulars may be obtained from the undersigned on payment of £1, returnable to firms submitting a bona fide Tender. Prints of the contract plan can be obtained on payment of 5s., not returnable. Remittances must be made payable to Mr. F. Steadman, City Treasurer.
Tenders, endorsed "Tender for Pumping Machinery," are to be addressed to the Chairman of the Works Committee and delivered to the Town Clerk's office before Noon on Wednesday, the 23rd March, 1927.
The Corporation does not bind itself to accept the lowest or any Tender.
By Order,
T. THOMAS,
City Engineer.
Guildhall, Hull,
2nd March, 1927. 4802

County Borough of Rotherham. RECONSTRUCTION OF CHANTRY BRIDGE.
Contractors experienced in the construction of reinforced concrete bridges and retaining walls are invited to TENDER for the RECONSTRUCTION of CHANTRY BRIDGE.
The work will consist of a Reinforced Concrete Highway Bridge, 94ft. skew span and 60ft. wide; 340 Lineal Yards Reinforced Concrete Retaining Walls, about 23ft. high; Dredging 400 Lineal Yards of River Don; Temporary Steel Footbridge, 70ft. span; Restoration of existing 15th Century Bridge and other incidental Works.
General conditions, specification, bill of quantities and plan of site are obtainable from Vincent Turner, M. Inst. C.E., Borough Engineer, on receipt of details of previous work of this description carried out, and a deposit of Five Pounds, which deposit will be refunded on the return of the documents or on the receipt of a bona fide Tender.
The contract drawings may be inspected at the Borough Engineer's Office, Rotherham, or at Messrs. L. G. Mouchel and Partners, Ltd., 36-38, Victoria-street, S.W. 1.
Sealed Tenders, endorsed "Reconstruction of Chantry Bridge," shall be delivered to the undersigned not later than 10 a.m. on Monday, 21st March, 1927.
C. L. DES FORGES,
Town Clerk.
Municipal Offices, Rotherham,
21st February, 1927. 4823

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PUBLIC NOTICES

Great Southern Railways.

The Directors are prepared to receive TENDERS for the SUPPLY, DELIVERY, and ERECTION of about 500 TONS of STEEL WORK required for the Renewal of the Superstructure of a Viaduct about 500ft. long.

The steel work includes 36 Plate Girders, about 54ft. long, with arched plate flooring.

The Directors are prepared to receive ALTERNATIVE TENDERS for the above STEEL WORK SUPPLIED and DELIVERED ONLY.

In addition, TENDERS are INVITED for the SUPPLY and DELIVERY of about 40 TONS of STEEL WORK in Six Small-span Bridges.

There are separate sets of drawings and specifications for the viaduct and for the six smaller bridges. Either set can be obtained on payment of £1 1s. (which is not returnable) from the Chief Engineer, Mr. J. F. Sides, Broadstone Station, Dublin.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders must reach the undersigned not later than the first post on the 21st March, 1927.

C. E. RILEY, Secretary.
Kingsbridge Station, Dublin. 4850

Great Southern Railways.

The Directors are prepared to receive TENDERS for DREDGING at Rosslare Harbour. The dredging is for the purpose of maintenance and the areas to be dredged have previously been dredged to the depths now proposed as finished depths. The estimated minimum quantity of material to be removed is 100,000 cubic yards.

Copies of the plan and specification can be obtained from the Chief Engineer, J. F. Sides, M. Inst. C.E., Broadstone Station, Dublin.

The Directors do not bind themselves to accept the lowest or any Tender.

Tenders must reach the undersigned not later than the first post on the 24th March, 1927.

C. E. RILEY, Secretary.
Kingsbridge Station, Dublin. 4896

Easington Union.

TO HEATING ENGINEERS.

The Guardians of the Poor of the Easington Union invite TENDERS for the SUPPLY and ERECTION of NEW HEATING, HOT WATER SUPPLY, STEAM, and other PLANT at their Poor Law Institution and Infirmary at Easington, Co. Durham. Tenders must include for the whole of the work specified.

Plans, specifications, and schedule of quantities may be seen on application to me or to the Consulting Engineer, Mr. T. J. R. Kiernan, B.Sc., M. Inst. C.E., of 17, Victoria-street, Westminster, S.W. 1, between the hours of Ten and Four (Saturdays excepted).

Copies of the plans and specifications can be obtained ONLY FROM ME on payment of Two Guineas (which will be returned on receipt of a bona fide Tender). Sealed Tenders, endorsed "Heating and other Plant, Easington Union," to be delivered to me not later than 10 a.m. on Monday, 21st March, 1927.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
(Signed) J. M. LONGDEN,
Clerk to the Guardians.

Union Offices,
Easington, Co. Durham. 4908

Metropolitan Asylums Board.

DRY DOCKING, &c., OF R.A.S. "ALBERT VICTOR."

The Board invite TENDERS for DRY DOCKING and REPAIRING the HULL and FITTINGS of the RIVER AMBULANCE STEAMER "ALBERT VICTOR."

Specifications, conditions of contract and form of Tender may be obtained at the Office of the Board, Victoria Embankment, London, E.C. 4.

Tenders, addressed as noted on the form of Tender, must be delivered at the Office of the Board not later than 10 a.m. on Wednesday, 23rd March, 1927.

G. A. POWELL,
4865 Clerk to the Board.

South Indian Railway Company,

LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. STEEL RAILS and FISHPLATES (approximately 3350 Tons).
2. PLATFORM ROOFING and FOOTBRIDGE.
3. TIE BARS, GIBS and COTTERS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Steel Rails and Fishplates," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 18th March, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specification No. 1, and of 10s. for each copy of Specifications Nos. 2 and 3.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1.
1st March, 1927. 4904

The Madras and Southern

MAHRATTA RAILWAY COMPANY, Limited, 25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for :—

(1) FILES.
(2) 27 TONS RED LEAD (Dry) and 25 TONS WHITE LEAD (Moist).

Tenders are due in on Tuesday, 22nd March, 1927, by 2 p.m. Tender forms obtainable at above address; fee One Guinea each, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 4902

City of Birmingham Electric

SUPPLY DEPARTMENT.
HAMS HALL GENERATING STATION.
APPOINTMENT OF CIVIL ENGINEERING CLERK OF WORKS.

APPLICATIONS are INVITED from qualified Civil Engineers for the POST of CIVIL ENGINEERING CLERK OF WORKS to supervise the Construction of the First Section of the New Hams Hall Electrical Generating Station and Works incidental thereto.

Salary £600 per annum.

Forms of application, which can be obtained from the undersigned, must be sent in, accompanied by copies of not more than three recent testimonials, and endorsed "Civil Engineering Clerk of Works," not later than the 19th March, 1927.

E. J. JENNINGS,
Secretary.

14, Dale End, Birmingham,
28th February, 1927. 4870

Egyptian Government.

The Egyptian State Railways have VACANCIES for TWO LOCOMOTIVE INSPECTORS on contract for a period of two years at a salary of 360 Egyptian pounds per annum.—Full particulars and form of application can be obtained on application at the offices of the CHIEF INSPECTING ENGINEER, Egyptian Government, 41, Tothill-street, London, S.W. 1. 4897

Egyptian State Railways.

First-class BRIDGE ENGINEER REQUIRED for Egypt. Two to three years' contract, maximum salary £900, qualification B.Sc. Honours and ten years' practical experience in Bridge Building.

Application form, copy of contract, can be obtained from the office of the CHIEF INSPECTING ENGINEER, 41, Tothill-street, S.W.1, and must be addressed to him marked "Bridge Engineer." 4898

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED by Firm Manufacturing Ball and Roller Bearings, ASSISTANT TECHNICAL MANAGER, with sound theoretical and practical experience.—Write, stating experience, salary, and when available, Box D.P. 2902, Willing's, 90, King-street, W.C. 2. 4905 A

WANTED, Experienced ENGINEER for Chemical Works near London.—Address, stating salary, age, and send recent testimonials.P2893, The Engineer Office. P2893 A

WANTED, GENTLEMAN Having Entrance and connection with first-class engineering and shipbuilding firms to INTRODUCE MANUFACTURING FIRM of highest standing, London and Glasgow; £1000 an advantage.—Address in first instance, P2895, The Engineer Office. P2895 A

APPLICATIONS are INVITED for the POST of MECHANICAL ENGINEERING INSPECTOR. Candidates should be between 28 and 35 years of age, and should have had at least five years' experience in a Mechanical Engineering Drawing-office.

Applications will be considered only from those who have had a full practical training and a first-class experience in general engineering practice.

Apply in first instance by letter, stating age, qualifications, experience, and salary required, to BRUNNER, MOND and CO., Limited, Northwich. 4889 A

ASSISTANT CIVIL ENGINEER WANTED; Must be good draughtsman, with thorough knowledge of Reinforced Concrete Design and General Engineering training.—Apply in first instance, stating experience, age, and salary required, to Box 289, Robertson and Scott, Advertising Agents, Edinburgh. 4885 A

BUYER WANTED for Large Company, Capable of exercising independent judgment, knowledge of buying for engineering a recommendation. State age, experience, and salary required. Only first-class men considered.—Write, "BUYER," c/o Messrs. W. H. Smith and Son, Hornby House, Liverpool. 4880 A

CHEMIST (GRADUATE) WANTED for Group of Collieries in County Durham, accustomed to Sampling and Analysing Coal and conversant with Coke and Gas Manufacture.—Address, stating age, salary required, with copies of recent testimonials, P2882, The Engineer Office. P2882 A

CHIEF WORKS MAINTENANCE ENGINEER REQUIRED for Large Factory. Must be good organiser and able to control men and shops. Only first-class men considered. State age, experience, and salary required.—Write, "ENGINEER," c/o Messrs. W. H. Smith and Son, Hornby House, Liverpool. 4881 A

ENGINEER, Aged 30 to 45, REQUIRED, to Take Control of Plant, Power and Premises of Large Engineering Works in the London district. Must be thoroughly experienced in the maintenance and repair of all classes of Machine Tools, also Lighting, Heating, and Power Plant.—Address, stating age, full details of experience (with copies of references), and salary required, 4831, The Engineer Office. 4831 A

ENGINEER WANTED, with Good Experience in the design, manufacture and testing of Two-stroke Cycle Oil Engines up to 200 H.P., to Take Charge of Department. Must have had sound experience in responsible position. Give full particulars and state salary required.—Address, 4802, The Engineer Office. 4802 A

EXPERIENCED ENGINEER WANTED, to Take Full Charge of Outside Erection of Large Industrial Plant of Steel and Ferro-concrete Buildings, Heavy Foundations, Gantries, Timber and Ferro-concrete Wharves, &c.—Address, stating age, experience, and salary, P2889, The Engineer Office. P2889 A

GENERAL MANAGER, Responsible to Directors only, for Large Marine Oil Engine Works. Keen and energetic organiser and estimator.—Address, giving fullest particulars of experience and positions held, 4886, The Engineer Office. 4886 A

MILLWRIGHT for India, Able Supervise Turning, Fitting, Smithy, also Effect Repairs; age 35-40, teetotaller; three years' agreement. Salary commence 600 rupees monthly, increasing 50 rupees each year. State experience, send testimonials.—Address, 4871, The Engineer Office. 4871 A

REQUIRED, WORKS MANAGER for Large Textile Machinery Works. Must be highly experienced in modern methods, be a good organiser and have a thorough control of men. Good salary will be paid. —Apply, with full particulars of past experience, to the SECRETARY, Fairbairn Lawson Combe Barbour, Ltd., Hope Foundry, Leeds. 4907 A

RATE FIXER.—ASSISTANT RATE FIXER REQUIRED for large Engineering Firm in East Midlands. State age, experience, and salary required. —Address, 4884, The Engineer Office. 4884 A

REQUIRED, EXPERT, to Organise and Push the Sale of good cheap line of Woodworking Machines.—Address, stating salary, experience, &c., 4877, The Engineer Office. 4877 A

WANTED, a DRAUGHTSMAN with Works Experience, for Chemical Works near London.—Address, stating age, experience, and salary, P2892, The Engineer Office. P2892 A

WANTED for West of England, First-class DRAUGHTSMAN, with Modern Manufacturing Shop and Drawing-office experience of Winding, Haulage and Pumping Plant (Steam and Electric). State age, experience, including details of any specialities, and salary required.—Address, 4891, The Engineer Office. 4891 A

CRANE DRAUGHTSMEN.—A GOOD OPENING for suitable MAN with experience in Level Luffing Gantry Cranes, able to work on own initiative. Salary about £350 per annum, according to experience. —Address, stating age and full particulars, 4923, The Engineer Office. 4923 A

DRAUGHTSMAN REQUIRED; Must Have Had experience in Design of Motor Cars and Accessories.—Address, stating age, salary, &c., 4872, The Engineer Office. 4872 A

DRAUGHTSMAN REQUIRED, Used to Conveying and Mechanical Handling Plants. First-class men only with full experience will be considered. State age, experience, and salary required.—Address, 4893, The Engineer Office. 4893 A

DRAUGHTSMEN. — SEVERAL First-class DRAUGHTSMEN WANTED IMMEDIATELY, preferably with experience of High-speed Oil and Petrol Engines. Applicants must be fully qualified men. Particulars of age, experience, and salary desired.—Address, "ENGINE," Wm. Porteous and Co., Glasgow. P2896 A

DRAUGHTSMAN WANTED for Cocoa and Chocolate Works in the North of England; qualified in Machinery Design and Lay-out Work. Age about 30. —Address, giving experience, wage required, and references, 4879, The Engineer Office. 4879 A

DRAUGHTSMAN WANTED, Used to Colliery Screening Plants, State age, experience, and salary required.—Apply, GOODALL, CLAYTON and CO., Ltd., Hunslet, Leeds. 4873 A

MECHANICAL and GENERAL ENGINEERING DRAUGHTSMEN REQUIRED, to prepare detail and scheme drawings for proposed new plant. Candidates should be between 28 and 35 years of age and the following training is essential :—Sound technical training at a University or Engineering College, three years' workshop experience with well-known firm of general engineers, three years' drawing-office experience.

Applications will be considered only from first-class men with the above experience.

Apply in the first instance by letter, stating age, qualifications, experience, and salary required, to BRUNNER, MOND and CO., Limited, Northwich. 4890 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN, Thoroughly Experienced in Cable Machinery and General Plant Work, REQUIRED by CALLENDER'S CABLE and CONSTRUCTION CO., Ltd., Belvedere, Kent. None but fully qualified applicants will be considered. 4926 A

JUNIOR DRAUGHTSMAN, Specially for Centrifugal Pumps, low and high lift, and with a knowledge of Steam and Power Pump. State age, experience, and salary required.—Address, 4924, The Engineer Office. 4924 A

STRUCTURAL STEEL WORK.—WANTED, a DETAIL DRAUGHTSMAN. State age, experience, salary required, when at liberty.—Address, 4921, The Engineer Office. 4921 A

FOREMAN for Foundry, Non-ferrous Metals, London district. First-class man of experience with Moulding Machines and Hydraulic Castings. State wages and experience and full particulars, with copies of testimonials.—Address, 4900, The Engineer Office. 4900 A

INDIA.—First-class MACHINE SHOP FOREMAN REQUIRED, with thorough knowledge of modern methods.—Write, with details of experience and copies of testimonials, to "Z.F. 775," c/o Deacon's, Fenchurch-avenue, London, E.C. 3. 4916 A

SITUATIONS WANTED

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

American Coal and the Gas Industry.

DEALING with the recent labour troubles and their effect on the gas industry, Dr. Charles Carpenter at last week's general meeting of the South Metropolitan Gas Company regretted, not for the first time, that to provide against such outbursts of unrest it was necessary for the company to lay down large stocks of coal in reserve. Such stocks, he said, not only involved large sums for re-handling, but never gave such good results, either in the matter of gas or by-products as freshly wrought coal. Last spring the company had nearly a quarter of a million tons of coal in its reserve stocks, a quantity representing a fifth of a year's consumption. It was soon seen, however, that even that extreme provision would not see the company through the emergency, and it turned its attention to foreign coal—American rather than continental. The American coal, of which some 800,000 tons were purchased, was found to be highly satisfactory. The only difficulty that arose was in connection with its discharge. The steamers bringing it across the Atlantic were not only very much larger than those normally serving the company, but were more fitted for the carriage of grain than of coal. With the assistance of the Admiralty, however, the difficulty was overcome by discharging the vessels at Portsmouth and Sheerness, with the aid of the facilities existing at those ports for the coaling of war vessels. The quality of the American coal, Dr. Carpenter stated, was very good. Its freedom from ash provided strong evidence of the care with which it had been mixed and cleaned. Compared with the North Country coal normally used by the company, it gave a higher yield of both gas and tar, and produced a coke with a lower ash content. The company throughout the period of the coal dispute was enabled to maintain the full calorific value of its gas without resort to the expedient of mixing water gas with it, for the manufacture of which, indeed, it has no equipment. The company found its dealings with the American coal exporters highly satisfactory, no disposition to take advantage of our industrial troubles being encountered.

American Coal and the Railways.

THE experience of the gas industry with American coal, as recorded by Dr. Carpenter and summarised above, was certainly more fortunate than that of others, although in this matter we ought to remember that coal suitable for making gas is not in general suitable for steam-raising purposes, and *vice versâ*. In particular, our railways would appear to have encountered considerable trouble with the American coal on which they were largely dependent during and after last year's dispute in the British mining industry. At the general meeting last week of the London, Midland and Scottish Railway Company, Sir Guy Granet gave the shareholders an impression of the virtues of American coal as different as it well could be from that conveyed by Dr. Carpenter. The company, he said, spent £3,700,000 more on the purchase of fuel than the sum estimated at the beginning of the year to be sufficient to cover its needs. It found the Americans unwilling or unable to sell coal on demand. Supplies for early delivery could not be obtained unless forward contracts extending into January and February of this year were also entered into. In addition, the price that had to be paid was very high, and as it increased, the quality of the coal deteriorated. Its bad quality was not confined simply to the production of a reduced volume of steam. It reacted on the locomotives, and led to an increased number of casualties and to a considerably increased demand on the services of the company's repair shops. By its increased cost, its reduced steam-raising efficiency, the increased maintenance costs which its use entailed, and the immobilisation of an abnormal number of locomotives in the repair shops, American coal, Sir Guy stated, had added enormously to the company's operating difficulties.

An Institutional Amalgamation.

THERE are many who at the present moment regret the multiplication of technical societies and institutions, and who are strongly in favour of a process of amalgamation between those bodies covering the same or similar fields. To those who favour amalgamation as a general principle the news will be welcome that an example will in all probability shortly be provided by the Royal Aeronautical Society and the Institution of Aeronautical Engineers. The first-named body has passed the sixtieth year of its existence. The second is a post-war foundation which within the past year or two has undoubtedly grown in power and status. Negotiations for amalgamation were instituted in 1925, but failed in spite of the fact that on both sides many felt that no insuperable objections to a combination of activities and interests had been disclosed. During 1926 the negotiations were renewed, and early this year a joint committee under the chairmanship of Sir George Beharrell reached an agreed scheme of amalgamation. That scheme now awaits the ratification of the members of the two bodies. Under it the amalgamated society is to be known as "The Royal Aeronautical Society" (with which is incorporated the Institution of Aeronautical Engineers). The title "Hon. Member of the Institution of Aeronautical Engineers" is to be dropped and those holding it, together with "Members" of the Institution, are to have the option of describing themselves either as Fellows of the Royal Aeronautical Society or as members of the Institution of Aeronautical Engineers. Associate members of the Institution may choose to describe themselves as such as as associate fellows of the Royal Aeronautical Society. The Council of the amalgamated society is to consist of a chairman and twenty members, of whom thirteen are to be members of the Council of the Society and seven members of the Council of the Institution. Seven members of the Council of the Society are to resign in order that the necessary members of the Council of the Institution may be co-opted. The proposals for amalgamation will be considered at the annual general meeting of the Royal Aeronautical Society on the 29th of this month.

The North-East Coast Exhibition.

WE referred in a Journal note published in our issue of January 28th to the proposed North-East Coast Exhibition, which was then arranged to take place at Newcastle-on-Tyne in May, 1928. The feeling has been generally expressed, particularly in the heavier industries of the Tyne district, that such an early date gave little opportunity for industry to recover from the long period of depression, and the serious dislocation caused by the coal stoppage. In deference to this opinion it was decided at a meeting of the Executive Committee held last week to defer the Exhibition until 1929. It has now been recommended to the General Committee that the North-East Coast Exhibition should take place in 1929, from May to October. A resolution was also passed thanking the guarantors for their support and further requesting them to carry forward their promises to the later date. Up to about the end of last month over £90,000 had been guaranteed, and with the later date, it is now hoped that the full amount required will be forthcoming within another month or so.

The Shipbuilding Employers' Federation.

THE recent appointment of Sir Andrew Duncan, Vice-president of the Shipbuilding Employers' Federation, as chairman of the Central Electricity Board, foreshadowed a change in the headquarters staff of the Federation. As, in addition, Sir Charles Sanders, the present secretary, has decided to retire very shortly, appointments have had to be made with a view to filling these positions. Mr. Thomas Biggart, who since the inception of the Federation has been intimately connected with its work, and is consultant to the Central Board, has been elected an Honorary Vice-president of the Federation. The new secretary is Mr. John S. Boyd, who comes to the work with railway experience. Since the amalgamation of the railway groups, Mr. Boyd has been assistant to the superintendent of the north-eastern area of the London and North-Eastern Railway Company at York. He represented the railway on the Central Wages Board, and has served on many London committees dealing with staff questions. He is a graduate of Glasgow University and gained his M.A. degree with honours in Economics in 1909. Three years later he took his LL.B. degree and obtained the Robertson Scholarship as the most distinguished graduate of the year. Mr. Boyd will be assisted in his secretarial duties by Mr. Alexander Belch, who now becomes deputy secretary. Mr. Belch came to London with Sir Andrew Duncan as his chief assistant, when the headquarters of the Federation were removed to London. He has had considerable experience in industrial negotiations, and received his early training with Messrs. Biggart, Lumsden and Co., solicitors, Glasgow.

Midland Counties Electric Supply Company.

AT the fourteenth ordinary general meeting of the Midland Counties Electric Supply Company, Ltd., recently held at Winchester House, Old Broad-street, E.C., the chairman, Mr. George Balfour, explained that the increased connections recorded last year were greater than the total connected load in the year 1919. The average price received for current in the counties of Derbyshire and Nottinghamshire was only 1·164d. per unit sold, and in Leicestershire and Warwickshire 1·465d., the difference being due to the load factor. It was necessary to install additional plant at the Spondon station of the Derbyshire and Nottinghamshire Electric Power Company, and at the Avon station of the Leicestershire and Warwickshire Electric Power Company. Arrangements were now being made for the erection of another 12,000-kilowatt turbo-alternator with boiler plant, &c., at Spondon, and for additional boiler plant at the Avon station, now connected by a 33,000-volt line with the Hickley station. The 33,000-volt line from Spondon to Coalville was being extended southwards to Hinckley, so that in a few months the three generating stations would be interconnected by a trunk line in duplicate, about 53 miles long, thus enabling the stations to assist one another. In order to secure new business and develop new districts, 92 miles of high-tension lines and 64 miles of low-tension distributors were laid during the year, increasing the total length of high-tension lines to about 430 miles and the low-tension distributors to about 250 miles or a total of some 680 miles.

An International Register of Aircraft.

FOR five years the Bureau Veritas has, with the approval and support of the French Government, published a complete register of French aircraft and has had in force an elaborate system of rules for their survey and construction. To extend that work in the direction of creating an international register of aircraft and of instituting national classification rules that would have international acceptance, co-operation has now been arranged between the Bureau Veritas, the British Corporation for the Survey and Registry of Shipping and the classification societies in America, Japan, Germany and Norway. The British Corporation has, according to the remarks made by its president, Mr. Robert Clark, at its thirty-seventh annual meeting in Glasgow last week, taken this step with the approval of the underwriters and the cordial support of the Air Ministry's Department of Civil Aviation. Mr. Maurice Denny has accepted the position of chairman of the Corporation's Aviation Committee, and the services of Major R. H. Mayo have been secured in a consultative capacity.

Modern Mining.

A LARGE company of colliery proprietors and others recently assembled at Kingsbury, near Tamworth, on the occasion of the opening of the sinking operations at the Dexter Pit of the Kingsbury Collieries, Ltd. Speaking at a luncheon which followed the ceremony, Sir John Cadman, chairman of the Anglo-Persian Oil Company, said that high-voltage current from the power station at Ham's Hall, Birmingham, would operate the mine as well as sink the shaft. Electric cutting tools would be used for mining the coal and electric conveyors for hauling it underground and on the surface. There would be no pit ponies, for electricity would take their place. Coal mining in the pit would be carried out in the modern scientific manner with the maximum economy and efficiency and with the least possible discomfort and danger to the miner. On account of improved plant and methods coal would in the future be produced more economically. The establishment of large central power stations would reduce the cost of power to a minimum and eliminate many boiler-houses and smoking chimneys. Everything bought for the mines would be purchased in larger quantities and therefore at lower prices, and everything sold would be sold to better advantage as part of a general scheme of distribution. The transportation of coal would proceed more smoothly through wider organisation and not in the present unsatisfactory and haphazard way and with everyone scrambling for wagons. Another advantage of co-operative working would be that each colliery would mine the coal most convenient for it to mine without regard to those boundaries which at present frequently caused coal to be mined at a loss or not mined at all, when it could be cheaply and effectively handled by a neighbouring and more conveniently placed unit.

Chemistry as a Career.

SPEAKING at the annual general meeting of the Institute of Chemistry, Professor G. G. Henderson, president of the Institute, remarked that there appeared to be some abatement of the enthusiasm for chemistry as a career, which was noted immediately after the war. It had not been the policy of the Institute, he said, to adjust the stringency of its regulations and examinations on any principle of supply and demand, but rather to indicate to those who believed that they had a bent for the science that it did not necessarily lead to fortune, that it called for hard work and sacrifices, and that, since the supply of chemists at present exceeded the demand, more than average ability was required for even moderate success. The industries of the country did not sufficiently absorb the scientific talent supplied by the universities, and it was to be deplored that many graduates had to turn to callings which had no direct relation to their technical education.

Shipbuilding on the Clyde.

ALTHOUGH there is a considerable amount of tonnage on order, which was added to during last month, the output on the Clyde has not yet showed many signs of recovery; indeed, the output for February is the poorest on record. In that month a total of fourteen vessels, aggregating about 8000 tons, was launched. Of the ships only two are ocean-going vessels, the remainder consisting of two light gunboats, one coasting steamer, eight pontoons, and a dock caisson, the majority of which were shipped abroad in sections. Last year thirteen vessels, with a total tonnage of 34,077 tons, were launched in the same month.

The Cardington Airship Shed and Mooring Tower.

No. I.

THE original airship shed at Cardington, near Bedford, was built for the Admiralty in 1916–17. It was a steel-framed structure, with an overall width of 254ft., a length of 700ft., and a clear height at the centre of 110ft. Both ends were provided with sliding doors and the approaches to them were protected against the prevailing winds by screens, 70ft. high and 700ft. long. In this shed several large rigid airships were constructed, the largest and last being the ill-fated R 38, a vessel of 695ft. length, 85ft. diameter and 2,700,000 cubic feet capacity. The construction of the R 38 severely taxed the capacity of the shed, so much so that, or so we understood at the time, the design of the vessel, particularly as regarded the disposition of the engine cars, was affected by the limitations imposed by the height of the shed.

When the Government in 1924 decided to build two airships of 5,000,000 cubic feet capacity each, it became at once obvious that the existing shed at Cardington would be much too small to house them. In actual fact, only one of the vessels is being constructed at the Cardington establishment. This vessel, the R 101, is to have a designed length of 720ft. and a diameter of 120ft. The other airship, the R 100, entrusted to the Airship Guarantee Company, will, we believe, be of slightly different dimensions with a length of 695ft. and a diameter of 130ft.

To accommodate the R 101 during her construction and subsequently, as required for overhaul, it was necessary to increase the length of the Cardington shed by 112ft., and its height by 35ft. It was considered to be unneceassry to provide doors at both ends of the shed, and to arrange wind screens beyond the doors as in the first structure.

In addition to extending and raising the shed, it was decided to erect at Cardington a mooring tower, in order to enable airships to be berthed without incurring the expenditure of time and the unavoidable risks incidental to housing the vessels within the shed. It is the object of these articles to describe the reconstruction of the shed and the construction of the mooring tower. For the facilities to do so, we are indebted to the Air Ministry and the different contractors, named hereafter, who were engaged on the works. We are also indebted to the Institution of Royal Engineers, Chatham, for permission to reproduce certain of the illustrations and facts contained in a paper dealing with the reconstruction of the shed, which Mr. A. R. Gibbs, of the Directorate of Works and Buildings, Air Ministry, contributed to the September, 1926, issue of that Institution's *Journal*. It may serve some purpose if we recall that another item in the programme of ground works rendered necessary by the present airship building programme, namely the airship shed at Karachi, India, was dealt with in our issue of December 24th, 1926.

THE RECONSTRUCTION OF THE SHED.

For the enlargement of the shed the design and tender of the Cleveland Bridge and Engineering Company, Ltd., were accepted after the details of the proposed construction had been examined at the Air Ministry.

To increase the height of the shed by the required 35ft. a plan was studied for raising the structure bodily by means of hydraulic jacks. This plan was not proceeded with, principally because the shed, being a bolted structure, lent itself readily to being dismantled and re-erected in an enlarged form. The decision to proceed by dismantling was found advantageous in practice, for it was discovered that it would be necessary to correct certain irregularities in the original shed which had been erected during the war—not by the Cleveland Bridge Company—when skilled labour was scarce. The cross sections of the original and the enlarged shed given in Fig. 1,* illustrate the method followed in heightening the original structure. The roof, it will be noticed, was not altered, the increased height being obtained by raising the vertical columns until the spandril pins of the arch were 35ft. above their original level. The vertical columns were strengthened by the application of channel sections to them, and their stability was secured by the erection of new raking struts running from the raised springing points of the arch down to new blocks of concrete lying outside the original foundations. The raking struts were braced to the original framework of the sides to secure lateral strength. The increased height of the building necessitated the provision of additional rigidity in the longitudinal direction. This requirement was met by the introduction of new diagonal and horizontal bracing members between the main transverse ribs.

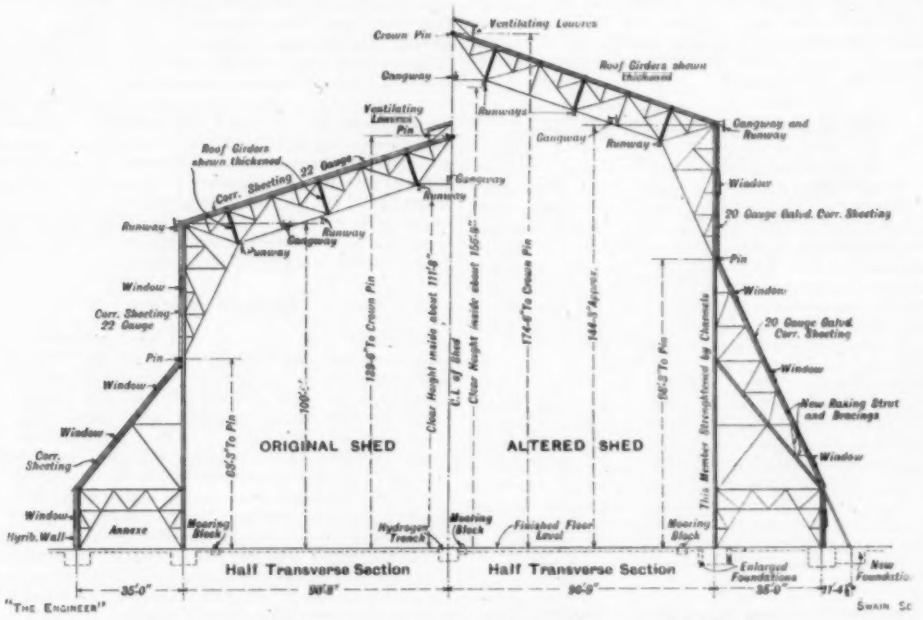


FIG. 1—THE ORIGINAL AND ENLARGED AIRSHIP SHEDS AT CARDINGTON

The door openings at the ends of the original shed had comparatively flat tops, the shed having been designed to accommodate two airships of the R 33 type. To accommodate a single airship of increased size it was decided to re-design the door end with an increased rise at the centre. The effective increase of height at the centre of the doorway was in this manner raised to 46ft., the clear height from the ground to the underside of the door opening on the centre line of the shed being 156ft. 8in.

As the increased height involved an increased load on the ground, the original foundations under the existing inside vertical columns were enlarged from a section 7ft. 6in. square to a section 11ft. 6in. wide by 7ft. 6in. deep. To carry out this work the original concrete was exposed to its full depth by trenches cut down each side. The sides having been roughened to secure a good bond, the new concrete was placed in position in the trenches, reinforcing members being inserted to secure that the new and old masses should act as one body. The foundation pressure nowhere exceeds 1½ tons per square foot.

The lengthening of the shed by 112ft. was accomplished by adding four bays to the original structure. From the spandril pins upwards, the ribs in the extension are similar to those in the original structure, but below the pins the frames, while of the same outline, are of simpler construction than could be obtained in a combination of old and new work.

The enlarged shed was designed to withstand a horizontal wind load of 35 lb. per square foot on the roof and of 30 lb. on the sides, ends and doors. A snow load of 5 lb. per square foot of the surface covered was added to the wind load.

The work of enlarging the shed was begun by erecting at one end a 7-ton steam crane on a steel stage, 40ft. high. This crane, in turn, was used to erect the large travelling stage illustrated in Fig. 2.

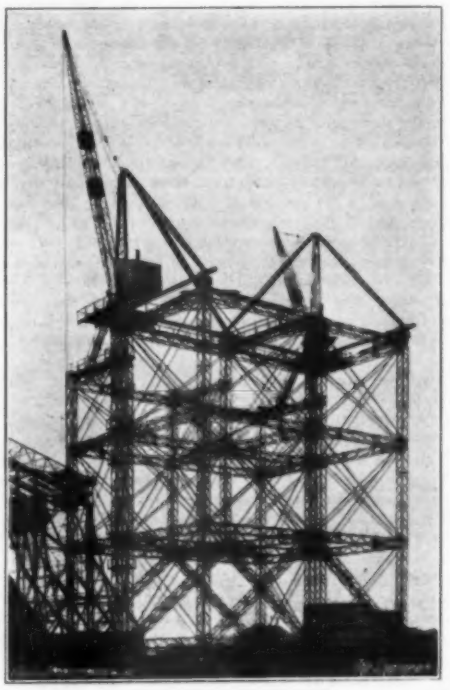


FIG. 2—TRAVELLING STAGE

The travelling stage was 120ft. high, 100ft. wide and 80ft. deep, and ran on a double track of 90ft. centres. On its top it carried two 10-ton steam cranes.

With the aid of the travelling stage, the doors at the north-east end of the shed were dismantled. The steel work, after being dissembled on the ground, was sent to Darlington, where much of it was embodied in the frames for the new permanent end of the enlarged shed. The stage was then moved forward and the arch ribs from the spandril pins upwards were dismantled in succession.

Meanwhile, the 7-ton crane had been taken down from its 40ft. staging and re-erected on the ground at the south-west end of the shed. With its aid the south-west doors were dismantled. These doors were sent to Darlington for re-construction, and on their return were re-erected partly by means of the 7-ton crane and partly by means of the travelling stage.

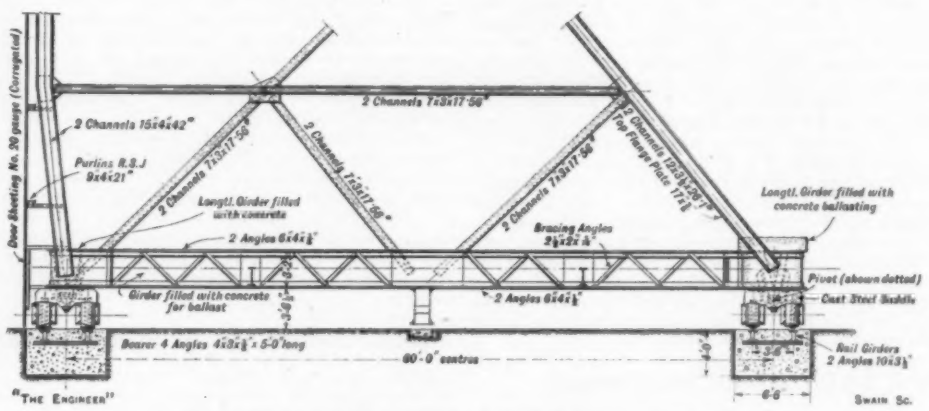


FIG. 3—SECTION THROUGH LOWER PORTION OF DOOR AND TRACK

While this work was proceeding, the new concrete foundations were being put in, and the vertical columns under the spandril pins were being strengthened by bolting to each a 9in. by 3in. channel section. The top of the travelling stage having been raised by 35ft., the cranes on it were used to erect the new raking struts and other bracing members. After a length of about 300ft. had been dealt with in this manner, the staging was brought back again to the south-west end and was set to work on the completion of the arch ribs, the subsidiary bracing and the sheeting for this portion of the building. In this

* Figs. 1 and 3 are reproduced by permission from the *Journal* of the Institution of Royal Engineers, September, 1926.

way the first 300ft. of the building was placed at the disposal of the airship authorities at an early date.

The remainder of the original length of the shed was thereafter completed, and the new work in the addition to the length erected. For the new work, the vertical columns and raking struts were erected in sections and when all the trestles had been completed up to the level of the spandril pins, the arch ribs forming the roof were lifted into position, each rib being raised in four sections, none of which exceeded about 5 tons in weight. The two cranes on the travelling stage enabled the two sides of each rib to be erected simultaneously.

After the fixed end of the shed had been erected, the travelling stage was dismantled by means of the crane on the 40ft. staging, which, in turn, was dissembled by means of one of the travelling stage cranes re-erected on the ground.

The sliding doors of the original shed were in four leaves, each of which was operated by means of a capstan. To open them required the efforts of a large number of men, and took about half an hour. Under a high wind, the load on each wheel supporting the leaves might rise to as high as 60 tons. The new doors are of similar type to the old, but instead of running on single lines at 36ft. centres, they move on two 3ft. 6in. gauge ways, lying at 60ft. centres. The rails supporting the trucks are riveted to girders tied transversely and embedded in concrete—see Fig. 3.

Each leaf of the four forming the doors consists of a series of horizontal girders faced with galvanised corrugated sheeting and carried on two vertical "A" frames. The four legs of each pair of "A" frames—as indicated in Fig. 3—are secured to horizontal girders, forming a base frame for the leaf. Concrete filled in between the base frame girders ensures the stability of the leaf. Four pivots transmit the weight of the leaf and its base frame on to the bogies in such a way that the four wheels of each bogie are equally loaded. The two leaves on each side of the centre line are linked together and are moved as one unit. Each pair of leaves represents a total weight of 470 tons, of which 248 tons are accounted for by the concrete ballast. With no wind the load on each wheel is about 15 tons, while with a high wind it should not exceed 30 tons. The two pairs of leaves are moved by chain gearing from manually operated winches fixed on the door frames. Six men can open the leaves in about ten minutes.

The completed shed has a floor area of 4¼ acres, and a capacity of 26·6 million cubic feet. The floor is of concrete and the sides are covered with galvanised corrugated sheeting. The roof is covered with Robertson's patented protected metal. Five rows of glazing on each side and at the closed end provide natural illumination to the interior. The new glazing is of Mellowes "Eclipse" type with ordinary wired rough rolled plate glass. The anti-actinic glass of the original structure was re-used and made to serve as far as it would go. Electric lights in gas-tight fittings and portable flood lights provide artificial illumination. Three internal gangways run along the whole length of the roof, and are connected to each other by three transverse gangways and to the ground by way of three staircases on each side of the shed. An external emergency escape ladder runs down one of the raking struts. There are two outside runways at the eaves for the suspension of painters' and glaziers' cradles. Internally, six runways are supported from the roof, each of which can take 4 tons vertically and simultaneously 1 ton horizontally. Ventilating louvres run the full length of the roof to prevent the accumulation of escaped gas. Water draining from the roof is taken from the gutters at the eaves into six tanks, each of 7000 gallons capacity, situated in the roof. These tanks are joined by service pipes to eight fi e hydrants.

The total weight of the steel used in the framework of the shed, exclusive of the foundation steel work, is about 3720 tons. The cost of the alterations was equivalent to 2½d. per cubic foot of the added capacity. Work on the enlargement was begun in October, 1924, and was completed in May, 1926. Although the operations were carried out in all weathers, no serious accident occurred.

On page 242 we reproduce two views illustrating the shed as reconstructed.

Delaware River Suspension Bridge, U.S.A.

No. II.*

Piers and Foundations.—Core borings made with diamond drills showed a considerable thickness of soft or disintegrated rock above the solid bed rock. These borings were made in sufficient numbers over the pier sites to enable the contours of the rock surface to be plotted on drawings, thus facilitating the construction of the caissons for the pier foundations. The caisson on the Philadelphia side is seated at a depth of about 60ft. below the water level, while that on the Camden side is seated at about 85ft.

For each pier, a caisson, 70ft. by 143ft., having a working chamber, 8½ft. high, was built. The general design of the caisson is shown in Fig. 6. The working chamber was entirely of steel construction, and had the load on its roof carried by transverse and longitudinal steel trusses, 15ft. deep. The chamber was divided into five compartments by four timber bulkheads, 3ft. thick. With this design the necessity for cross bracing in the working chamber was eliminated, thus facilitating the work of excavating and concreting within the chamber.

In the deep bed of concrete upon the steel roof was formed a long emergency chamber and passageway, connected with each compartment by a shaft or manhole and ladderway. This chamber, large enough to accommodate the entire working crew of about eighty men, was designed for refuge during blasting, and in case of accident, but fortunately it was not required for any emergency use. Above the working chamber the caisson was built up as a rectangular box, with walls of horizontal timbers, 12in. by 12in. The outside was covered with two layers of planking, the first laid diagonally and the outer one vertical, all joints being caulked, so as to be thoroughly water-tight. In this way the caisson was built up to a height of about 50ft., the walls being braced in both directions by a strutting of horizontal timbers, 12in. by 12in.

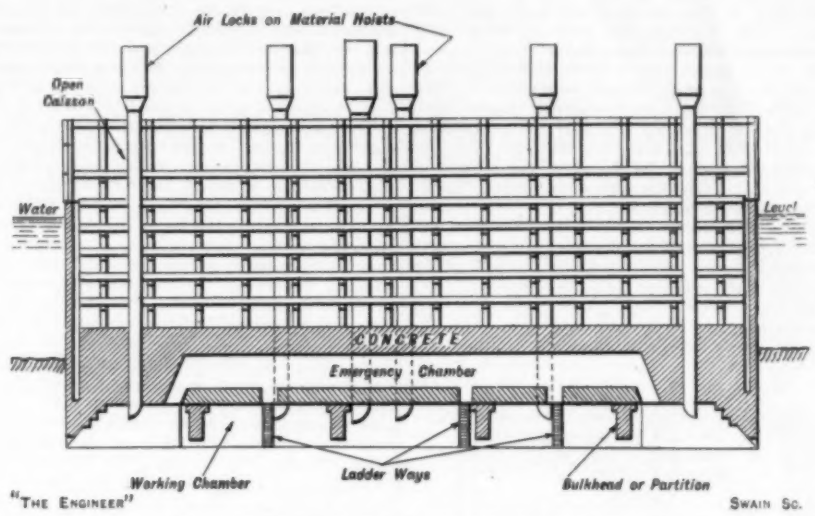


FIG. 6—LONGITUDINAL SECTION OF CAISSON FOR PIER

The main access to the working chamber was by two horizontal air locks, 8½ft. in diameter, and each large enough to accommodate thirty to forty men. These locks were at the level of the emergency chamber, and opened into it. At its outer end, each lock opened into a concrete shaft with stairway, so that if the caisson walls should leak the water would not enter or flood the air locks. In addition, there was a vertical air lock, 4ft. in diameter, opening into a man shaft, with a lift or hoist, but as the larger locks proved more convenient, this man shaft was but little used. Each compartment of the working chamber had two material shafts, 36in. in diameter, with bucket hoists and each was fitted with an air lock at the top.

Both caissons were built on covered ways in a shipbuilding yard. They had temporary bottoms and were built up to full height, so that their launching weight was about 1800 tons. Each caisson had a draught of about 12½ft., and was readily towed to the site of the pier. As the pier sites had been dredged to give 40ft. of water, the caissons were sunk easily about 28ft. before coming to a bearing. This sinking was effected by depositing concrete to a depth of about 12ft. Then the sinking was through stiff clay and disintegrated micaceous schist, the rock becoming harder with depth until solid bed rock was reached. All excavation was by hand, with pick and shovel, and only light charges were used in blasting. The spoil was loaded into buckets, hoisted through the material shafts and locks and dumped into barges for removal.

Concrete for filling the chamber was deposited through the air locks mounted on the shafts used for hoisting the excavated material, a trap door at the bottom regulating its discharge into the chamber. After the chamber had been filled and the concrete well packed against the roof, grout was forced in through holes to seal all voids. The main body of concrete for the pier was carried up during the sinking of the caisson, and its outer casing of massive granite ashlar masonry is built up to a height of about 35ft. above high water. The bearing load on the rock at the base of the caissons is about 6½ tons per square foot.

The Philadelphia caisson was launched April 24th, 1922; sunk, May 8th; and sealed July 1st. Its rate of sinking was 6½in. per day, and the maximum air pressure used was 28 lb. per square inch. The

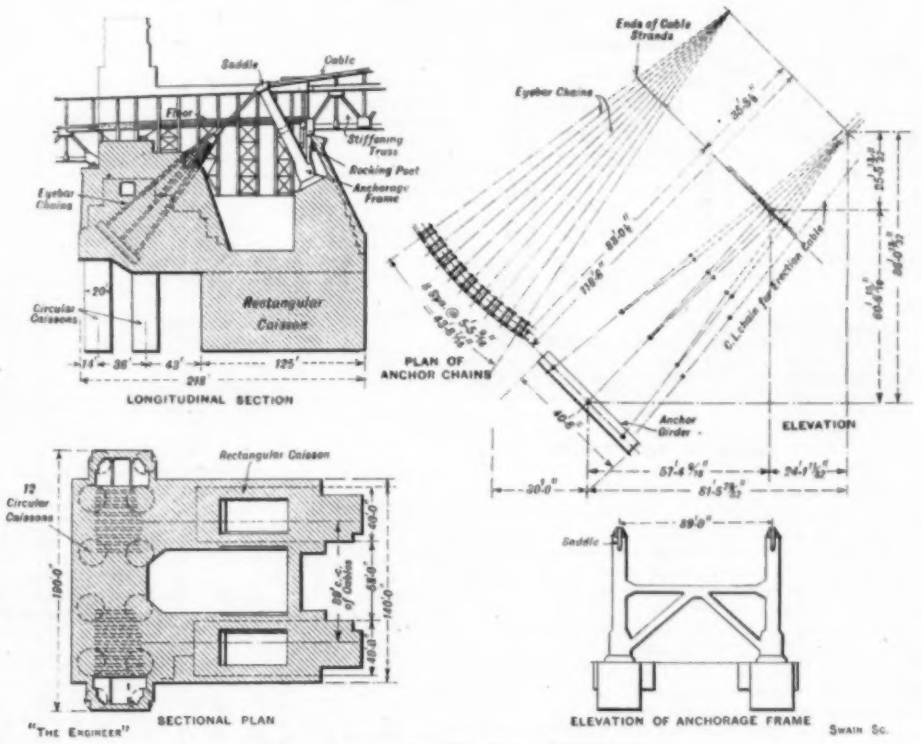


FIG. 7—ARRANGEMENT OF CABLE ANCHORAGES

* No. I. appeared February 25th.

Camden caisson was launched July 18th, 1922; it was sunk on August 9th and sealed on October 10th. The rate of sinking was 15in. per day, and the work required a maximum air pressure of 34 lb.

Cable Anchorage Foundations.—From their anchor attachments, the two cables rise at an angle of about 45 deg. to saddles on the head of an inclined steel gallows frame seated in the anchorage masonry, as seen in Fig. 2 *ante*. Beyond this frame an inclination of about 8 deg. begins the rise of the cables to the main towers. With this arrangement the anchorage has to resist the upward pull of the cable anchors, the inclined downward thrust of the steel frame, and the horizontal pull of the cables tending to shift the anchorage bodily towards the river. The general design of the anchorage is shown in Fig. 7.

In view of the great size of these anchorages, the foundations in each case consisted of a group of deep caissons, all built of reinforced concrete. Under each side of the massive masonry structure is a rectangular caisson, about 40ft. by 140ft.—or 40ft. by 125ft. for the Philadelphia anchorage—to carry the weight of the structure and to take the pull of the cables. Under the rear or approach end is a group of twelve circular caissons, eight of which are 20ft. in diameter and carried the excess load of the masonry structure until this load was relieved permanently by the pull of the cables. The other caissons, 16ft. in diameter, carry the towers and other auxiliary parts of the structure, which constitute architectural features. For the Philadelphia anchorage, including its foundations

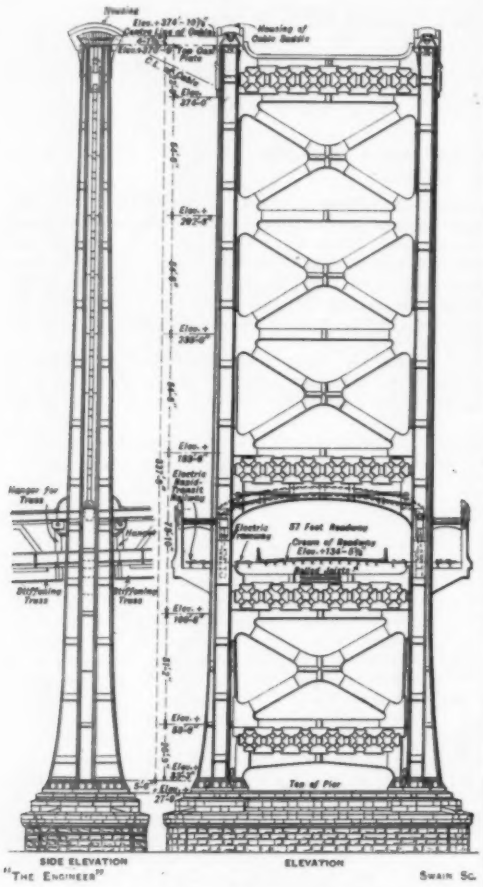


FIG. 8—DESIGN OF MAIN TOWERS

and superstructure, about 60,000 cubic yards of concrete were required, while for the Camden anchorage the quantity was 77,000 cubic yards. In each case about 1160 tons of reinforcing steel were used. The huge rectangular caissons were built up to a height of about 30ft. above the ground before sinking operations were started.

All these caissons were sunk by open dredging, using grab buckets of the so-called orange-peel type, composed of four sections. Each of the rectangular caissons had twelve dredging wells, 10ft. by 11ft., all of which were formed with recesses or grooves to receive steel bulkheads or decks for working chambers for sinking by the pneumatic process if that should have been found necessary. This necessity did not arise, however, but incidentally the recesses served to bond the filling or hearting concrete to the sides of the wells. Each of the circular caissons had a dredging well, 8ft. in diameter.

In cases in which the sloping surface of the rock caused trouble in landing or seating the circular caissons, the rock enclosed was broken up by means of a heavy chisel bar, operated by a cable and electric winch, until the caisson forced itself down by its own weight into the softer and disintegrated stratum of rock. In this position the caisson became sealed or water-tight, so that it could be pumped out and excavation continued to allow the caisson to reach the solid rock in which it was finally sealed. The depths reached were 98ft. to 103ft. below water level at the Camden anchorage, and 59ft. to 63ft. at the Philadelphia anchorage. All caissons were sealed tight and concrete filling was placed in the dry except that in one of the large rectangular caissons on the Philadelphia side there was some water. In this case the water was drained to two of the wells, which were finally sealed by placing concrete under water by means of tremies.

Contracts for the two piers and two anchorages were awarded in 1922 to the Holbrook, Cabot and Rollins Company, and the Keystone Construction Company, on their joint tenders of £334,000 for the piers and £418,700 for the anchorages.

Main Towers.—Each of the great steel towers supporting the cables and rising 345ft. above the masonry piers, or 385ft. above the high-water line, is a single frame consisting of two posts or columns, connected by transverse and diagonal members. A drawing of one of the towers is given in Fig. 8, and Fig. 10 shows a stage of the erection work.

The two massive columns are spaced 89ft. between centres to conform to the spacing of the cables. They are 7ft. by 40ft. in plan at the base, where they are seated on the masonry, and then taper rapidly to a smaller section, which gradually reduces to 7ft. by 12ft. at the top, the larger dimension being parallel with the cables. Each column is of cellular construction, having three parallel vertical webs in a longitudinal direction, 3½ft. apart, connected by three vertical transverse webs, the middle one of these latter also forming vertical ribs on the outer longitudinal webs. These vertical webs are connected at intervals by horizontal diaphragms, having apertures for manholes and ladderways which provide for inspection and interior painting. The tower complete weighs about 24,500 tons, and the load which it transmits to its bearings on the masonry pier is about 35,000 tons, including the cables.

Instead of having movable saddles on rollers to support the cables on the towers, the saddles—Fig. 9—in this case are anchored rigidly to the tower structure. They are of cast steel, annealed, fastened to the cap plates of the columns by 2in. bolts. The shoes or bases of the tower columns are in turn anchored rigidly to the masonry. In consequence, all movements due to varying loads and varying temperatures, as well as the relative movements of the central and side spans must be taken up by the bending of the towers. For this reason, the towers are built largely of silicon steel, the high unit stress of which permits the use of relatively light sections, thus providing the necessary flexilibity in the structure of the tower.

In this way allowance is made for the tower to bend so that its top can move 20in. either way from the vertical centre line, or a total movement of 40in., without injury to the steel structure. Under normal conditions, the towers are slightly inclined backward, with their tops about 5in. out of plumb. During the spinning of the cables, and before taking their permanent load, the towers were pulled 11in. to 18in. out of plumb by means of temporary backstays, so as to compensate for the eventual forward deflection of wires which form the cable into practically hexagonal section, where it is unwrapped. Transverse caps of similar shape are placed over the top of the cable at intervals and bolted to flanges on the sides of the saddle, with all joints caulked water-tight. A steel hood enclosing the saddle and the top of the tower post provides a weatherproof protection.

For seating the 4in. steel slab which forms the base

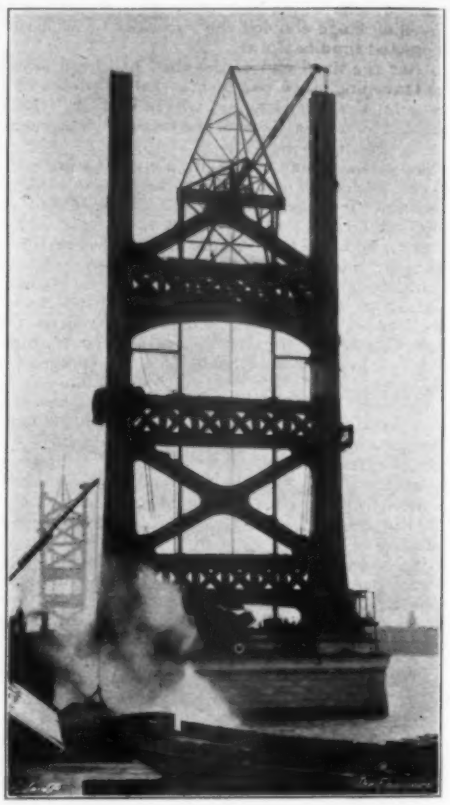


FIG. 10—ERECTING ONE OF THE MAIN TOWERS

of each of the columns of the tower, the surface of the granite pier was chipped level with air hammers for the entire area of the slab. Chisel draughts were run across this area to exact elevations at different points, as given by the engineer's levels, and the intermediate portions then carefully chipped away.

Erection of the steel work of the towers, as shown in Fig. 10, was done by derrick hoists, having jibs,

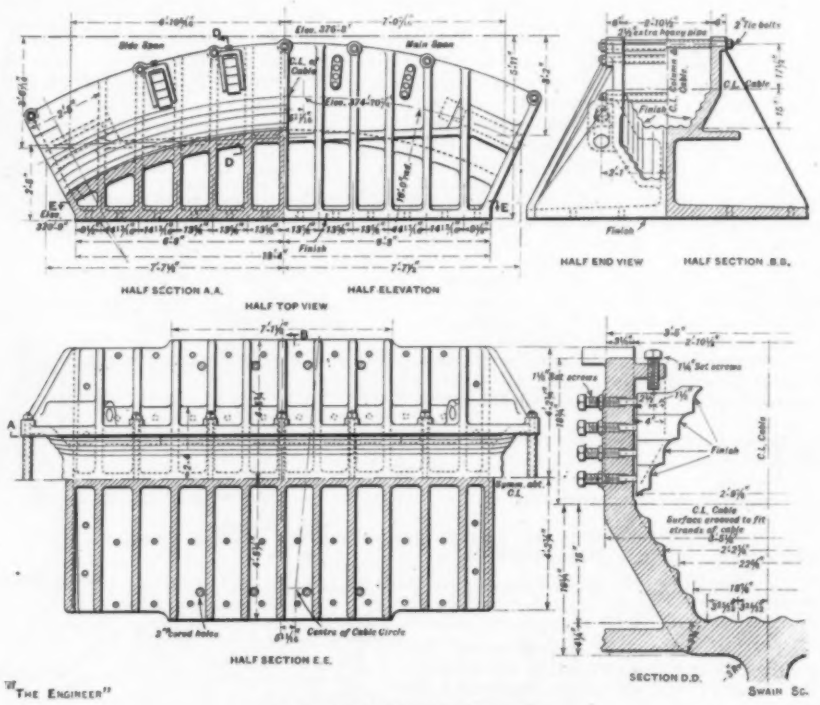


FIG. 9—CABLE SADDLE ON TOWER

which would occur when the towers carried the weight of the cables. The horizontal pull at the top of each tower column for a displacement of 12½in. is approximately 250,000 lb.

The cast steel saddles on the tower posts—shown in Fig. 9—give the cables a radius of 16ft. on the centre line. They form troughs of semi-hexagonal section to receive the cables, and are grooved to fit the bundles

60ft. long, these hoists being attached to the completed portion of the tower and moved upward to new positions as the work progressed. A novel method for handling the rivets consisted in the use of pneumatic tubes in which carriers containing the hot rivets were "shot" from the rivet heaters to the riveting gangs. For planing the ends of the massive built-up lengths of the tower columns, weighing about

50 tons each, two special rotary planers with 108in. cutting heads were built, these being the largest planers ever made. For both towers the steel work was fabricated and erected by the Bethlehem Steel Company.

Volta and Laplace.

AMONG the men of science whose names are destined to go down to the remotest posterity are those of Volta and Laplace, the centenary of whose deaths falls on March 5th. Differing vastly in the circumstances of their births, fortunes, nationality and mental endowments, they both pursued the path along which their genius led them, and both added greatly to the common stock of knowledge, the one by his fundamental discoveries and inventions in electricity, and the other by the exercise of his superb mathematical powers, which enabled him to illuminate and expound the mysteries and intricacies of planetary motion. Whether Laplace's profound studies in physical astronomy or Volta's ingenious inventions have influenced the progress of civilisation, the one more than the other, is beside the point; they were both patient, consistent inquirers into the laws of nature, and it is by such that the kingdom of knowledge is extended and the bounds of ignorance thrust back. The heritage they left is our possession to-day.

Volta and Laplace were representative men of an age of great scientific progress. It was an age which saw the foundation of modern astronomy by Herschel, and of modern chemistry by Lavoisier. The isolation of new elements, the explanation of combustion and oxidation, the discovery of the composition of air and of water, the enunciation of the theories of heat, the improvement of the steam engine, the invention of the balloon, the birth of the steam boat, the great geodetical expeditions, the solving of the problem of longitude, were all milestones in the progress of the exact sciences where there is room for the loftiest and most abstruse mathematical conceptions, and the closest and most faithful observation of fact. It was an age, too, when the monopoly long enjoyed by mathematics and astronomy gave way to a more generous curriculum and physics and chemistry came into their own.

Few of the new branches of science studied in the eighteenth century claimed more attention than electricity and magnetism, which, however, were still regarded as unrelated the one to the other. Many fundamental facts had been discovered, the friction machine was seen in every lecture room, the leyden jar had been invented, electric charges had been sent through wires and through water, substances were divided into "conductors" and "non-conductors," "electrics" and "non-electrics," the identity of electricity and lightning had been established, and in the protection to buildings and ships through the employment of the lightning conductors of Franklin, the world saw the first of those manifold applications of electricity in the service of man which we enjoy at the present time.

Volta's work began about 1770. It was no untilled field, no unexplored region that he entered upon. Born in 1745 at Como, he received a good education, and it was his own inclination which led him to abandon poetry for science. Letters written to Beccarici, and Nollet, when Volta was a youth testify to his early devotion to electricity, and in 1775, a year after he had been appointed teacher at the Liceo, Como, he invented the electrophone. Four years later he was made professor of natural philosophy at the University of Pavia. Several of his countrymen were electricians, and among these was Galvani, professor of anatomy at Bologna. Swammerdam, a century before, had noted the twitching of frogs legs under electric stimulus, and these experiments were amplified by Galvani and by Volta. Through them we have the electric battery. Galvani, in his explanation of the effect seen, clung mainly to the idea of animal electricity. Volta, however, demonstrated that all the effects could be produced by the contact of dissimilar metals, but it was Fabrouni who took into account the presence of chemical action.

Galvani's conclusions were criticised by Volta in letters to the Royal Society in London in 1793. In the next few years he was led to the plan of superimposing discs of copper and zinc in proper sequence with moistened paper or leather, and so in 1799 came the Voltaic pile, also made known to the world through a letter read at the Royal Society in March, 1800. Eagerly seized on by experimentalists, with the pile and the "Couronne des Tasses"—also Volta's—discovery followed discovery; Nicholson decomposing water; Davy isolating potassium and sodium; and Oersted at last discovering the capital fact that an electric current flowing in a circuit affected a magnetic needle. Of the splendid harvest which sprang from the seed sown by Volta, he himself reaped but little. He continued a professor at Pavia till 1815, then was made director of the philosophical faculty at Padua, but the last eight years of his life were passed in quiet retirement at Como. Twenty-eight years ago the centenary of his great invention was commemorated by the holding of an Exhibition at Como, and now to-day another such gathering is being arranged for to celebrate the centenary of his death.

If the era of Volta was an age of great extension of the physical sciences it was also the age of the "Mécanique Analytique," "Mécanique Céleste," and the "Theorie de Chaleur," immortal works second only to the "Principia." It was in this domain of theoretical advance that Laplace's work mainly lay. Four years junior to Volta, he started with no advantage of birth, but this son of a peasant of Normandy, by twenty had engaged the attention of D'Alembert, by thirty was recognised as one of the foremost of European mathematicians, and by forty had extended the theory of gravitation to the most difficult problems in the motions of Jupiter, Saturn and the moon. With these studies he had also joined hands with Lavoisier in experimental work, but his greatest strength lay in his easy command of analysis. His earlier works are to be found principally in the form of memoirs to the Paris Academy of Sciences; his work after the Revolution is summed up in his three books, "Systeme du Monde," "Mécanique Céleste," and "Probabilities." These were the three words inscribed on his monument. Like Euler he continued to work till the end.

The life of Laplace loses nothing in interest from the times in which he lived. He passed through the Revolution unscathed, under the Empire he became Senator, Chancellor and a Count, while after the Restoration, Louis XVIII. made him a Marquis. The son of a poor peasant became a landowner, and at his pleasant estate at Arceuil, where he passed the last twenty years of his life, many a man of science paid him the respect due to age and distinction. In his time he had been prominent in all the great scientific institutions of Paris, and at last became President of the Academy of Sciences. His old age was pleasant and easy, but he had the melancholy fate of outliving most of his contemporaries. Lavoisier he had seen fall on the scaffold, Morige died in 1818, Berthollet and Delambre in 1822. Laplace was almost the last of the old school, but in the hands of Arago, Biot, Poisson, Becquerel and their fellows the great traditions of science in France were worthily upheld.

Early Modern Plough Design.

By G. E. FUSSELL.

ALTHOUGH Fitzherbert pointed out some four centuries ago that there were many different ploughs used in different parts of the country, the local practice in each part was to go on making the pattern which it was customary to use there. The plough that had always been used continued to be used and no one was concerned about the principles upon which it should be built. It did its work more or less efficiently according to the dexterity and skill of the smith: the ploughman was at his mercy.

The development of the spirit of scientific inquiry into first principles in the seventeenth century passed by such a rude instrument as the plough, although a great deal of attention had been paid to other forms of mechanical design. It was not until the latter part of the eighteenth century that some attention was given to the design of ploughs. "The truth is," says Small, "that it has been neglected by those persons who have turned their attention to machines, as a rude tool, unworthy of their attention. Such persons imagined that anything could do for the clumsy operation of turning up the ground, and that there could be no nicety in a work which was successfully performed by the ignorant peasants." Before that time many writers had advised that a plough commonly used in one locality and on one type of soil might be carried to another part of the country and used there with a corresponding advantage to the farmers of the new locality; but such changes are difficult to introduce into rural communities. Not only were the farmers themselves antagonistic to changes, but even when they had been convinced of the advantages of the "foreign" plough, their men often made bad work on purpose to show that the new implement was inferior to that customarily used by them.

Increasing interest in agriculture and the trend of eighteenth century inquiry, however, stimulated agricultural theorists to inquire into the principles upon which the most efficient type of plough should be constructed, and there is a curious unanimity amongst those who first attempted to solve the problem.

In 1774 a writer, who preserves his anonymity, but discloses the cast of his mind in his signature, "A Practiser of both the Old and the New Husbandry," speaks deferentially of the two wheel plough, but cannot conceal his preference for the swing plough, an engraving of which he reproduces from "The Complete English Farmer." This he recommends, especially when a semicircular section is cut out of the bottom of the mouldboard to reduce friction. This is perhaps one of the earliest attempts to modify the design of the mouldboard for that purpose.

Three years later James Black endeavoured to discover the real mechanical principles which underlie the work of the plough. His book, "Observations on the Tillage of the Earth and the Theory of Instruments Adapted to this End," appeared in 1777.

He condemns wheels and says that, if the proper angles are maintained between the line of draught and the point of entry into the earth, the plough will practically guide itself, which is much the same as our anonymous farmer says, but he adds that "a plough is a moving wedge to divide and overturn; it should therefore be constructed according to the laws of moving bodies. . . . These, according to Sir Isaac Newton," he sets out and proposes to follow in the design of the implement.

This was followed in 1784, the year when James Small's famous "Treatise of Ploughs and Wheel Carriages" appeared, by a pamphlet written by an Essex farmer entitled "A Letter on the Construction and Use of the Improved Foot Plough," which describes how much more easily it did the work than the ploughs of forty years before, and describes the breast. "It is 3ft. long, 1ft. deep, and straight at bottom, but convex, or rounding outwards behind as it rises; if a proper degree of strength be given to it it cannot be too thin. Its form ought nearly to resemble a wedge upon an easy slope before, that it may follow the share, and pass under the earth as easily as possible. With this intention, it should be narrow before, approaching close to the share, and open behind." It is of wood and is covered with a thin iron plate.

Small has achieved undying fame as the first who endeavoured to lay down the principles of plough design in as scientific a manner as the mechanical knowledge of his day would allow, but there is no doubt that he, in common with all other great innovators, owed much to his predecessors and to his contemporaries. He concentrated and clarified what other men had been thinking in a muddled and indefinite manner, and his work remained the classic of the subject for nearly fifty years.

Of the mouldboard, which had been much neglected, he says, the construction "is of a very nice and complex nature, and requires considerable skill to make it in such a manner as to perform its work to the wish of the ploughman, and with as little labour as possible to the cattle." . . .

"It must keep the plough in a proper hold in the ground; it must remove the earth to the furrow side, and it must turn it over."

In earlier ploughs than this, he says that the furrow slice is turned over, but only because the straight mouldboard is so long that the slice, which is balanced up on an untouched ridge of earth, must needs topple over; but always there is this untouched ridge below each furrow-slice. "Accordingly mouldboards have long been made with a curve or twist," and have differed very much in shape with the varying taste of the individual ploughman. He believed, however, that there must be an universal type of mouldboard that would do the required work. The principle on which this mouldboard should be built was that "the back of the sock and the mouldboard should make one continued fair surface, without any interruption or sudden change. The twist, therefore, must begin from nothing, at the point of the sock, and the sock and the mouldboard must be formed by the very same rule." He proceeded to construct his mouldboard of wood and attempted to set out a mathematical method of discovering the exact shape, so that the natural twist of the earth in being lifted up by and passed over the mouldboard should be reproduced in the shape of the board. He produced a scale showing the width and curve of the board when required to cut a certain width and depth of furrow. In his experiments he used a plank to represent the furrow slice and watched its action on passing over the mouldboard carefully.

Some nine years later tables akin to Small's were published by James Bailey in his "Essay on the Construction of the Plough," 1795. His idea was essentially that of Small. The curve of the breast should follow the natural twist of the furrow slice in being turned over. He took various soils in his experiments. A slice of 54in. in length was twisted over as in ploughing, and he worked out the angles at every 3in. of the length, thus providing himself with data on which to design his plough breast. The curve must be continuous, and he is careful to deal with the line of draught and the point of entry into the earth, so as to secure that the draught animals shall not be driving the point into the ground and pulling against themselves, so to speak.

In 1808 Small's theories were once more repeated, almost in his own words, by Andrew Grey in "The Ploughwright's Assistant," but, of course, plagiarism is by no means more unusual amongst the early agricultural than any other class of writer. For instance, "Although the plough is of vast importance to man, yet it has long been very much neglected," is very reminiscent of Small's comment. It is true that Grey acknowledges that Small was the first mechanic in Scotland who published rules for the construction of the plough, but perhaps that is hardly a sufficient reason for copying him almost verbatim, and detailing his method of obtaining his data as if it were his own.

But Small's fame is not likely to be injured by Grey, because a writer in the *Quarterly Journal* of Agriculture in 1828 acknowledges the benefits he conferred upon agriculture and most of the later writers have awarded him the palm for early modern plough design. This writer says "the forming of the mouldboard of cast iron, instead of wood covered with plates of iron, as it anciently was, is a great improvement . . . because, when a mould is once formed on correct principles, any number can be cast and sent to every part of a county. . . ."

A plough made wholly of iron is illustrated in Bailey's "Advancement of Arts," 1773, but it did not become a commonplace until the nineteenth century was somewhat advanced, and the use of iron for this purpose was largely due to the ability the material gives for turning out a standard pattern. It is interesting to recall that, at the same time as all these designers were working on the foot plough, Arthur Young was consistently recommending the Norfolk wheel plough, because its draught was only that of two horses, and it could be managed by one man "both to drive and hold the plough"; but he was not concerned with the design of the plough in quite the same way as these early mechanics were.

THE ELECTRIC POWER POSITION IN CANADA.

AT the annual meeting of the Association of the Municipal Electrical Utilities of Ontario, on January 19th, C. A. Maguire, chairman of the Ontario Hydro-Electric Power Commission, delivered an address setting forth the attitude of the Commission on the power situation. He pointed out that the increased demand for power in Ontario was at the rate of 75,000 to 100,000 horse-power per annum, and he made a strong plea for the maintenance of Province rights in connection with power development, under public ownership, which were being attacked by powerful financial interests. The attempt now being made to secure a renewal of the charter of the Georgian Bay Ship Canal, granted twenty years ago, should, he urged, be strongly opposed, as the charter was simply sought for the power rights contained in it. Regarding the proposed St. Lawrence development, he expressed the hope that an agreement would shortly be reached between Canada and the United States. The Commission was opposed to the one stage plan of development, which it considered uneconomical, but the American Government was not committed to that system. After some discussion resolutions, in which the Association reaffirmed its stand against rights being given to private corporations to develop power in Ontario, were adopted. They opposed the renewal of the Georgian Bay charter, and asked the Federal Government to accept the Hydro-Electric Commission's plans for the development of the St. Lawrence waterways. C. A. Maguire was re-elected President of the Association.

THE American Bureau of Standards has just issued a paper by F. W. Dunmore, which describes the development of a portable radio direction finder with but two controls—one for tuning and one for balancing. This direction finder operates over the frequency band from 90 to 7700 kilocycles—3300 to 39 m. The direction finder is of the simple rotating coil type. The receiving set is of the superheterodyne type, with the controls reduced to one by the use of a cam-operated condenser. The wide frequency range is made possible by a set of seven interchangeable plug-in direction finder coils, each with a corresponding heterodyne generator coil and cam for operating the auxiliary tuning condensers.

A New Water Sterilising Process.

A NEW method of sterilising water which is claimed to be effective, simple to apply, and cheap, is, at the present time, attracting a good deal of attention in France. It was introduced by Monsieur Phillippe Bunau-Varilla, an engineer whose activities in Central America are well known, and whose name was closely associated with the history of the Panama Canal at the time when efforts were being made to salve that enterprise before it was finally transferred to the United States. During the war he was in charge of the water supply at Verdun, and, for the purpose of sterilisation, he employed chlorine, using from 1 to 4 milligrammes per litre, which in British measures means from about 10 lb. to 40 lb. per million gallons. Apparently there was no de-chlorination or any further treatment, and the complaints regarding the taste of the water were so strong that Monsieur Bunau-Varilla set himself to ascertain by experiment if the chlorine could be reduced sufficiently to render the water palatable without diminishing the sterilising effect of the chemical to any appreciable extent. By gradual degrees, reductions were made until it was found that satisfactory sterilisation was, we are given to understand, effected with a dose as small as 0·8 deci-milligramme of chlorine per litre, which represents in British measures 12·8 oz. per million gallons. Continuing the diminution, it was found, so it is reported, that satisfactory results could still be obtained with a dose as small as 0·2 of a deci-milligramme—one-fifth of a ten-thousandth of a gramme—of chlorine per litre, or 3·2 oz. per million gallons.

That result was reached during the war, and then Monsieur Bunau-Varilla was badly wounded and had to have a leg amputated, with the result that he could do nothing further till after the conclusion of hostilities. Then he again went on with his inquiries.

The fact that sterilisation of polluted water could be effected with such minute doses of water caused him to think that the action must be physical and not chemical, and, eventually, after a long study of the problem, he was led to the belief that it was due to ultra-violet or similar rays. He was partly led to this conclusion by the fact that the effect is, he claims, instantaneous. The introduction, he says, of an infinitesimal quantity of chlorine into water will instantly destroy all bacteria in the immediate vicinity of the point of addition of the chemical, while in an extremely short space of time, the whole volume of water is sterilised. He asserts that the ultra-violet ray theory is proved by the fact that water, after sterilisation by his process, assumes a radio-active quality which is sufficiently pronounced to destroy bacteria that are introduced into it. Furthermore, he claims that the theory is proved to be correct for the following reasons :—

(*a*) If a tube of quartz containing some water be immersed for part of its length in a bowl containing polluted water—not deeply enough, of course, for the two fluids to mingle—and if chlorine in the minute proportions he recommends, be added to the water in the quartz tube, then the bacteria in the bowl will all be destroyed. That, he maintains, shows that the action must be due to something which can get through the quartz, and points to that "something" being ultra-violet rays or rays of even shorter wave length.

(*b*) The effects are even more pronounced in the dark than in daylight, which, he points out, is a characteristic of ultra-violet ray action.

It was six years after Monsieur Bunau-Varilla had arrived at the point which he reached at Verdun before anything on a practical scale was done with his process. Then, however, Rheims, which was suffering from typhoid fever in epidemic form as well as from excessive infantile mortality, decided to install a plant operating on his system, being led to do so by the favourable reports made upon the latter by eminent bacteriologists. Now, Rheims has a population of some 100,000 persons, and the cost of the installation was, it is reported, only 3000f., which at the present rate of exchange means less than £25, while the daily cost of working is given at from 7f. to 10f. The results attained are certainly astonishing. According to the testimony of Dr. Téchoneyres, the director of the Bureau d'Hygiène at Rheims, there has not been, during the three years that the plant has been in operation in that town, a single case of typhoid fever of local origin, whereas, before it was put to work the number of deaths due to typhoid was 5 per cent. of the population per annum. Then as to infant mortality—though it is not easy to see why the improvement should have been so great as it has been, since young infants do not ordinarily drink water—the death-rate which had been as an average 106 per 1000 births during the years 1921, 1922 and 1923, fell in 1924, 1925 and 1926 to an average of 82 per 1000. Furthermore, intestinal maladies are nowadays practically unknown.

Then, again, Carcassone, having heard of the success at Rheims, installed a similar plant in 1925. That interesting old walled city had, from time immemorial, suffered from epidemics of typhoid fever, attributed to the drinking water drawn from the river Aude, which was the only source available. After the plant was got to work the epidemics of typhoid fever entirely disappeared, but they broke out again when, for some reason or other, the plant ceased to operate, though they disappeared once more when the treatment was restarted. Last year, the system was, we understand, adopted with success, first at Monte Carlo and then at Sables d'Olonne, where ozone treatment had previously been used, at Aix-les-Bains and Compiègne.

The accompanying drawing—Fig. 1—shows the arrangement of the plant at Rheims, while the half-tone engravings, Figs. 2 and 3, are reproduced from photographs of two installations at Carcassone. It was necessary, of course, to have a means of automatically adding the chlorinating liquid regularly to the water in the required minute doses, and the drawing shows the apparatus which Monsieur Bunau-Varilla devised for the purpose. From the suction side of the pump a tube A is taken in the manner shown to the bottom of a receptacle B, which can hold 50 litres of the chlorine solution. The receptacle is hermetically closed, saving for a tube of small diameter, which is open at the top to the atmosphere, and which is taken down practically to the bottom of the liquid. In the tube A are arranged two jets or nozzles C and D, which have tapering restricted orifices, the upper nozzle C being $^{5}/_{10}$ mm. and the lower nozzle D $^{8}/_{10}$ mm. in diameter. The tube has also a branch which leads to a control tank E, and just above the point where the branch takes off a further tube F of smaller diameter is sealed inside the

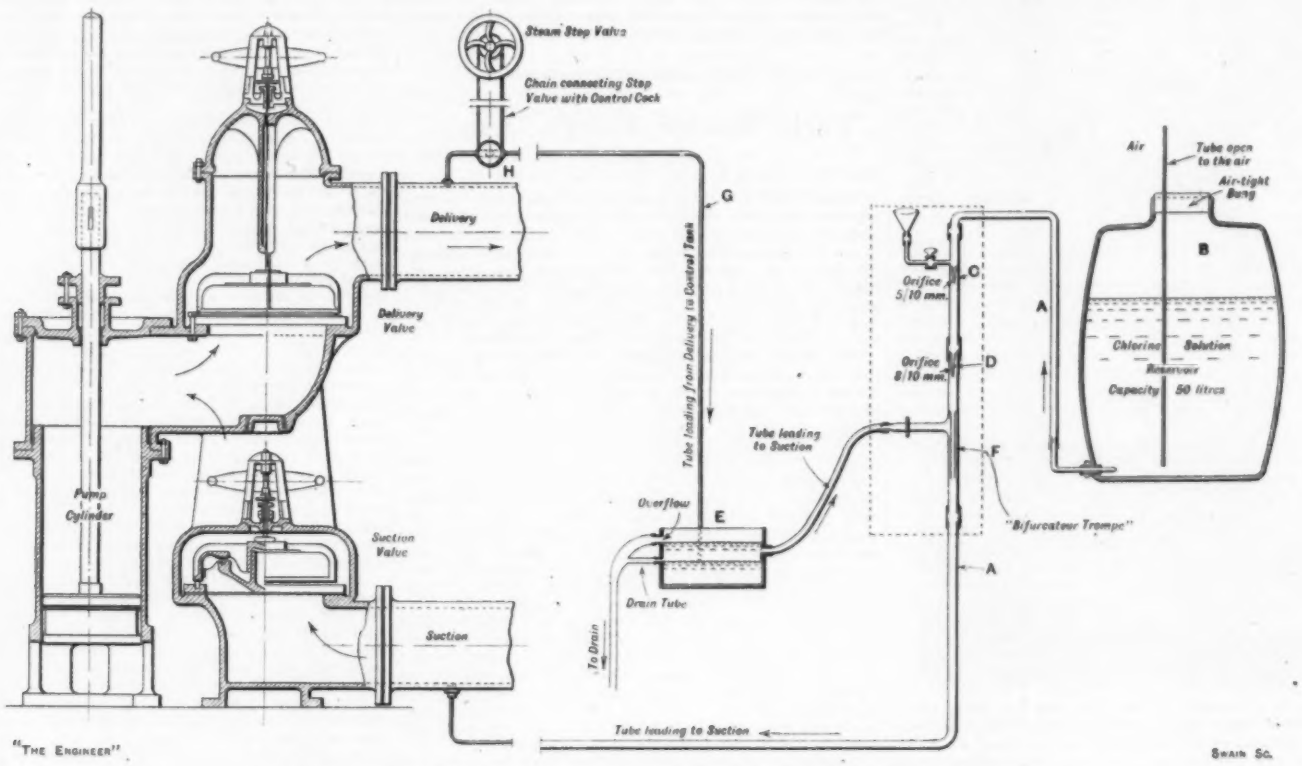


FIG. 1—DIAGRAM OF THE BUNAU-VARILLA SYSTEM OF WATER STERILISATION AT RHEIMS

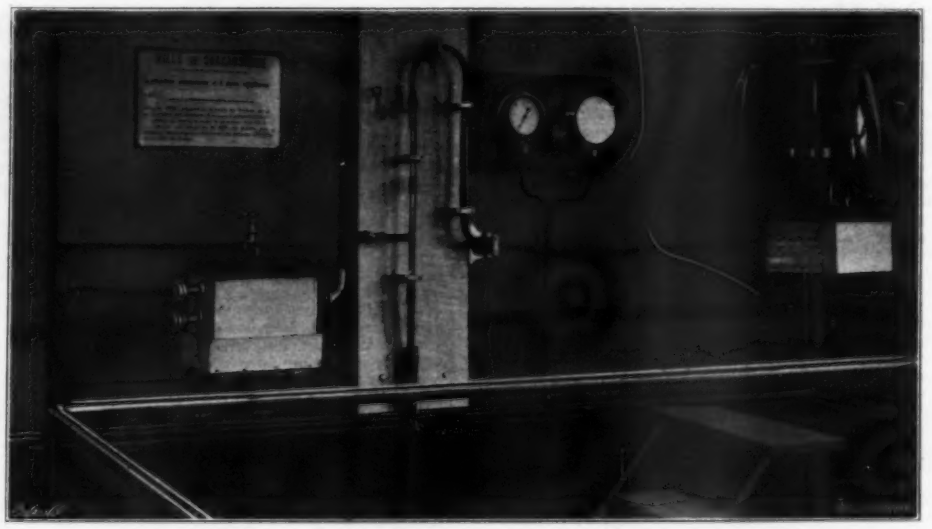


FIG. 2—BUNAU-VARILLA STERILISATION PLANT AT CARCASSONE

tube A, which at that point is of glass, the orifice of the tube F pointing downwards and reaching down well below the branch to the control tank. This arrangement the inventor terms the "Bifurcateur Trompe," and it is, in effect, an ejector. Its constituent parts are shown to a larger scale in Figs. 4 and 5, which represent respectively the upper and lower portions of the apparatus.

From the delivery of the pump a pipe G which is controlled by a valve H is led to the control tank E. The valve H is operated by chain from the spindle of the stop valve of the engine driving the pump. When the pump is not running, the valve H is closed and no water is delivered to the tank E, but it opens as soon as steam is given to the pump, the movements of the stop valve of which it follows exactly. The delivery of the pipe G is considerably in excess of the quantity of water which the drain tube from the control tank can carry away, so that when the pump is at work the level of the water in the tank rises till the overflow level is reached, with the result that the outlet from the tank leading to the "Bifurcateur Trompe" is submerged. Then, at each suction stroke of the pump a certain amount of water is drawn from the tank E into the pipe A, and at the same time a minute dose of chlorine solution is drawn from the receptacle B through the orifices C and D, and the "Bifurcateur Trompe" F into the pipe A, and thence into the body of water going to the pump. By this arrangement a definite predetermined dose of chlorine solution is added to the water being pumped, but, as soon as the pump is stopped by the cutting off of the steam, the valve H is closed, the delivery of water to the tank E ceases, so that the water level in the latter falls and uncovers the outlet to the "Bifurcateur Trompe," and the pipe A, and no further chlorine

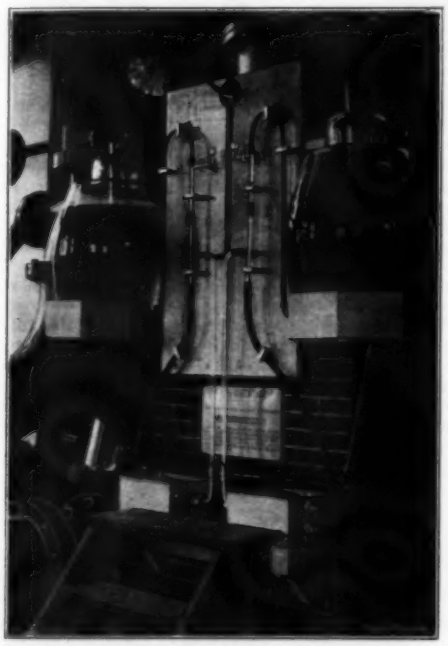


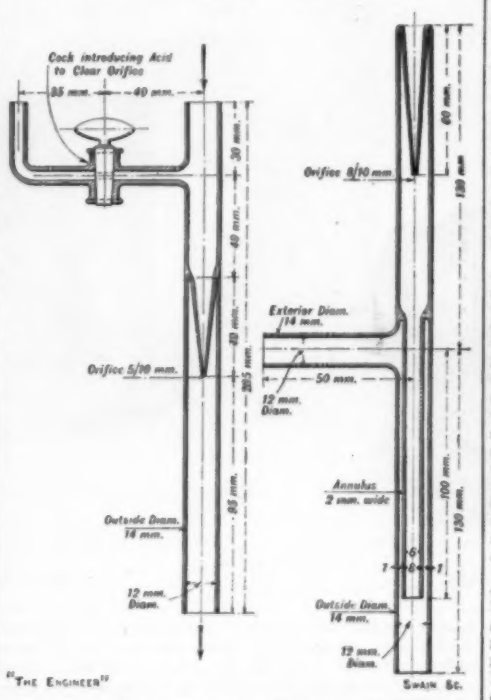
FIG. 3—WATER STERILISING PLANT AT CARCASSONE

solution can be drawn from the receptacle B. It may be added that not only is the delivery of the pipe G in excess of the quantity which can pass away from the tank E by the drain tube, but it is also in excess of that quantity *plus* the amount which is sucked into the tube A. When the pump is at work, therefore, the orifice leading from the tank to the tube A is always submerged and the chlorine solution in the desired quantity is added to the water being pumped.

It will be noticed in the drawings that above the upper nozzle in the "Bifurcateur Trompe" there is a funnel which is controlled by a cock. It is for the introduction of a small quantity of hydrochloric acid to clear the orifices of the nozzles should they become clogged with crystals from the chlorine solution.

This method of water sterilisation does not appear to have received, as yet, a permanent name. First it was called the "Auto-Javellisation" system, after the name of Eau de Javel, under which designation commercial chlorine is sold in France. That name was changed to "Verdunisation," in memory of the town of Verdun where it was first employed, and now Monsieur Bunau-Varilla, to whom we are indebted for the information contained in the foregoing and for the accompanying illustrations, proposes to call it "Sterilisation by radiolysis" or the "radiolytic system." He believes that it is capable of other developments beyond the sterilisation of water, and suggests that it may be possible to adapt it for the destruction of bacteria in sewage. In any case the inventor has not patented it, desiring that his country should have full advantage of it without payment. Incidentally, therefore, anyone is at liberty to use it.

We have not, as yet, had an opportunity of personally investigating the system, and therefore for the moment we refrain from making any comments concerning it, saving to say that Monsieur Bunau-Varilla's experience would appear to differ widely from that met with elsewhere. In this country and in the United States the dose of chlorine varies usually from 0·2 to 0·5 part by weight per million gallons, that is, from 2 lb. to 5 lb. per million, as against his $3^1/_2$ oz. If the dose be lowered to a figure still very greatly in excess of his dose, then complete sterilisation no longer results. It is true, however, we believe, that no one in this country or America has yet tried the minute dose which Monsieur Bunau-Varilla uses and, as we understand it, he claims that it is only when these minute doses are employed that the effects he has noticed are observable. Then, again,



FIGS. 4 & 5—PARTS OF THE "BIFURCATEUR TROMPE"

here and in the United States it has, speaking generally, been found that time is required to get the maximum bactericidal effect; that is to say, the action is not practically instantaneous, as Monsieur Bunau-Varilla claims it is with his system. The bactericidal effect is by some ascribed to the liberation of nascent oxygen, and by others to a direct toxic action of the chlorine, and, in the opinion of one of our foremost experts on the subject, the ultra-violet ray theory appears to be untenable.

The Indian Railway Report.

DEALING only with the engineering features of the annual report for the year ended March 31st, 1926, of the Indian Railway Board, we notice that during the year 340·76 miles of new railway were opened, of which 144 miles were of the broad gauge and 145 miles of metre gauge. There were at the end of the year 1016 miles of broad gauge, 1115 miles of metre gauge, and 315 miles of 2ft. 6in. gauge under construction, and a total of 1102 miles of new line were authorised during the year. Of the new railway in the Khyber Pass, it is remarked: "The trade that passes through the Khyber Pass is already considerable, and it is hoped that the railway will still further increase its volume, thereby bringing profit and employment to many who in the past have subsisted with difficulty on the meagre agricultural resources of the country which it traverses."

The improved financial position of railways, resulting from the separation of finance, has enabled the Railway Board to adopt a bolder policy in the direction of new construction. The problem has been dealt with on the basis of examining the whole country in separate areas, roughly corresponding to the areas served by the different railway administrations, and continuous programmes of survey and construction are being prepared.

The total mileage of projects either sanctioned or being investigated by the end of March, 1926, amounted to between 6000 and 7000 miles, and it is hoped that, when all arrangements in this direction are in full swing, the total yearly addition to the mileage of Indian Railways will be in the neighbourhood of 1000 miles.

Mention is made of the various schemes at present in hand for the electrification of the suburban and main line services in Bombay, which, on the Great Indian Peninsula Railway, include the electrification of the main and suburban line to Kalyan and of the main lines to Igatpuri and Poona, and on the Bombay, Baroda and Central India Railway the electrification of the lines between Church Gate and Borivili. The work on the uncompleted portion of the schemes is being steadily pushed forward, and it is hoped soon to provide an electrified service on the whole of these sections.

The re-examination of the problem of suburban traffic in Calcutta is now approaching completion and the preparation of a revised electrification scheme is in hand as a result of the decision to proceed with the construction of the Calcutta Chord Railway with a bridge across the Hooghly at Bally. The Madras suburban traffic problem is also being dealt with. Additional tracks are being provided on the suburban section of the South Indian Railway from Madras to Tambaram, and the electrification of this section is also under investigation. The feasibility of electrifying other portions of the South Indian Railway is also under consideration in view of the possibility of a hydro-electric supply being available for this purpose.

A committee has been appointed to report on the adequacy of existing railway lines leading into and out of Calcutta, and to submit recommendations for co-ordinated plans of improvement to meet, in the most economical way, the present and future needs of the public and trade. A somewhat similar problem presents itself in Bombay, and the Railway Board decided to have a comprehensive investigation made by an independent expert in order that the future development of terminal railway facilities should be co-ordinated with a view to securing for the public the most convenient railway arrangements consonant with cheap fares and charges.

The process of standardisation of equipment advanced during the year under the direction of the Railway Board. The work of the Locomotive Standards Committee and of the Carriage and Wagon Standards Committee resulted in the consulting engineers being entrusted with the preparation of drawings and specifications preparatory to ordering a number of engines of the new types for trial and of detailed drawings for a number of new types of "Indian State Railway" wagons. Further, a Standing Committee of Chief Engineers was formed with three sub-committees for the standardisation of bridges, track, signalling and interlocking.

A number of schemes aiming at improvement in the capacity of the workshops of the North-Western, Oudh, and Rohilkhand and Eastern Bengal Railways in regard to repairs to locomotives and rolling stock had been proposed, and in some cases had been put in hand when the transfer to State management in 1925 of the East Indian and the Great Indian Peninsula Railways gave an opportunity of effecting economies and improving efficiency by a definite co-ordination of the work of the State Railway workshops. At the same time, improvements in workshop methods in Great Britain and elsewhere made it advisable that the whole of the workshop organisation on these railways should be overhauled and modernised. The Railway Board therefore appointed a committee, of which Sir Vincent Raven was the chairman, to inquire into and report on the subject. The committee submitted its report at the end of March, 1926, and it is now receiving the attention of the Railway Board.

As a result of further investigation of the problem of converting rolling stock for use with the automatic centre buffer coupler, it was found to be necessary to obtain more accurate knowledge of both the expenditure and the mechanical alterations involved in converting the large number of different types of wagons and vehicles in use. It had been recognised that in some cases fundamental alterations in the underframes would be necessary, but the problem, owing to the wide differences in design, was found to be somewhat more extensive than had been hoped. It was considered advisable to ask the consulting engineers to prepare detailed drawings and estimates of the alterations required in each of the various types of broad-gauge stock now in use before proceeding to establish conversion depôts for fitting the automatic centre buffer coupler to the existing stock. In the meantime, railways were instructed to continue to experiment with various types of automatic couplers and transition devices.

In order to meet the necessity for providing additional coaching stock, it was decided to provide a number of additional passenger units by obtaining steel coaches from abroad instead of following the usual practice of building coaches with wooden bodies in India. Sanction was accordingly given to obtain eleven rakes for the East Indian Railway in replacement of old low-capacity stock, and eleven rakes for the North-Western Railway. Each rake will consist of ten bogie coaches, equivalent to twenty four-wheeled units, and will furnish seating accommodation for approximately 1120 lower and 35 upper-class passengers.

RECENT DEVELOPMENTS IN MACHINE TOOLS.

A PAPER entitled "Recent Developments in Machine Tools" was read on February 25th before the Manchester Association of Engineers, by Messrs. G. E. Bailey, M.I. Mech. E., and Thomas Smith. The object of the paper, presented from the point of view of the user, was to provide engineers with a handy reference of developments in the various classes of machine tools dealt with, which are restricted to those of a "general purpose" nature, and to focus attention upon the great necessity of equipping factories with modern tools. A further object was to call attention to the responsibility of the machine tool industry to do pioneering work in order to enable industry generally to increase production and reduce the selling prices of their products, and by so doing combat the growth of imports and augment that of exports of machine tools. To achieve this latter object the authors recommend a closer exchange of views between the machine tool maker and the user.

The authors suggest as some of the most effective means of achieving efficiency in manufacture:—(*a*) A closer study by the manufacturer of the true costs of manufacture, prepared by qualified cost men and works accountants in order to show high spots which on further investigation will emphasise the necessity for improved equipments and methods; (*b*) a freer opportunity for machine tool makers to review manufacturers' plants; (*c*) a more responsible attitude on the part of machine tool makers and the backing up of their suggestions for substituting modern for obsolete machines by guaranteed performances and clear statements of savings to be made and advantages to be gained; such statements, the authors said, should include savings effected by reduced floor-to-floor times; reduced setting-up and floor instruction charges; reduced overhead charges; replacement of skilled operations by mechanical means; more accurate machining, resulting in reduced costs in the fitting and assembly shops, and reduction in capital investment owing to jobs being a shorter time in the shops and capital being turned over more often. Many different types of machines were referred to and illustrated by means of lantern slides.

K

The British Industries Fair.

No. II.*

THE arc welding equipment shown in Fig. 7 is one of the exhibits of the Metropolitan-Vickers Electrical Company, of Trafford Park, Manchester. These sets consist of a direct-current generator driven by an alternating or direct-current motor, together with the necessary control gear and switchboard, the whole set being assembled as a portable or semi-portable unit, and the self-stabilising characteristics of the generator enable the arc to give a constant heating effect without the use of a resistance. The whole of the energy that is generated is usefully employed at the arc, which results in a saving in the power consumption of from 33 to 67 per cent., according to the class of work. The characteristics of the machine also make it easy for the operator to strike and maintain the arc, and a new operator, it is claimed, learns to carry out his work more easily than he would otherwise do, whilst an experienced operator accomplishes more work in a given time. The equipments are supplied in various forms to meet all requirements. For multiple-operator working a number of generators can be arranged in conjunction with a common driving motor or a special generator with constant voltage characteristics may supply power for a number of welders, each having a stabilising resistance. Although this method may be somewhat inefficient in some instances, it is advantageous on account of its relatively low initial cost and the small amount of space required.

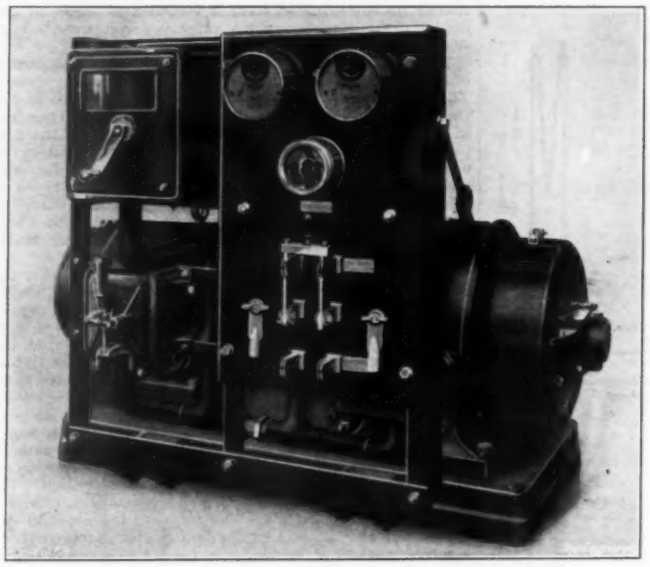


FIG. 7—ARC WELDING EQUIPMENT—METROVICK

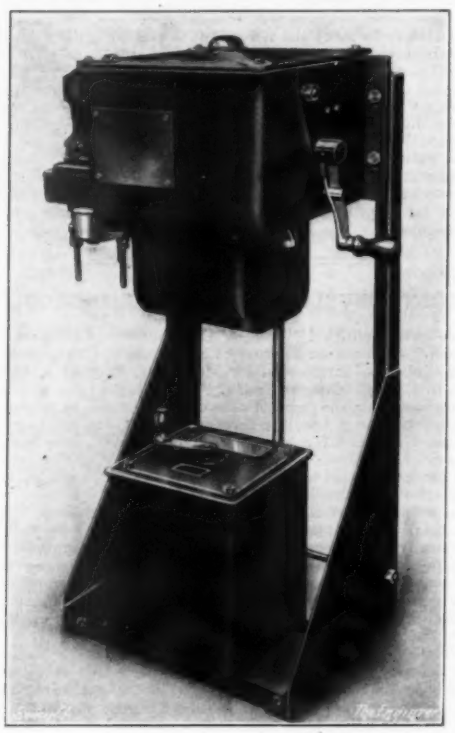


FIG. 9—A.C. MOTOR STARTING PANEL—METROVICK

The combined stator and rotor starting panel, shown in Fig. 9, was another of the Metropolitan-Vickers Electrical Company's exhibits. It has been developed for industrial use in conjunction with alternating-current motors up to 300 horse-power, and the apparatus has been designed with a view to reducing the initial and maintenance costs, all the parts being renewable and easily replaced. The switch mechanism is of the free handle type, and it operates through a toggle, giving two breaks per pole under an ample head of oil. The contacts, which are of the rolling butt type, are self-cleaning and operate so that arcing takes place at the tips and not on the contact surfaces. The cast iron case has a ventilated cast iron lid, and a welded sheet steel oil tank, provision being made on the case for mounting an ammeter, voltmeter or both. Normally, the circuit breakers are arranged for wall mounting, but they can also be mounted on pillars, as shown. The combination of circuit breaker and rotor starter exhibited constitutes an economical alternative to panel type switches with rotor starters for slip-ring motors. A corresponding combination with an auto-transformer starter is made for use with squirrel-cage motors, and in each case the circuit breaker can be interlocked with brush lifting and short-circuiting gear.

The company's coal cutter protection system was another notable exhibit. This improved system of protection for motor-driven gear used at the coal face has been developed to meet the demand for fuller protection on underground electrical appratus, and the system is especially applicable to coal cutters and coal conveyors driven by direct-started squirrel-cage motors. In addition to giving more adequate protection than has hitherto been afforded against injury to operators and apparatus, the system results in important savings in working costs and facilitates increased output. The essential apparatus consists of a special gate end starting box—see Fig. 8—containing a main contactor with protective and re-setting devices, a control switch suitable for mounting in any type of coal cutter, and a standard form of trailing cable with standard terminal plugs, complete control of the gate end apparatus being obtained by means of the control switch on the coal cutter.

The illustrations, Figs. 10 and 11, show one of A. Reyrolle and Co.'s exhibits, namely, a 400-ampère oil-immersed fuse switch for circuits working up to 660 volts, and designed to provide a simple, cheap and safe means of taking energy from supply mains to subsidiary circuits, such as power station auxiliaries or a group of small consumers. For comparatively small supplies of this nature it is, of course, essential to reduce the capital outlay and overhead charges to as low a value as possible consistent with safety, and to eliminate all parts that are unessential for complete security of the supply and of the user. The switch fuses under consideration are claimed to meet the requirements adequately, and to provide protection against overloads, their special feature being that provision is made for the safe and immediate isolation of the circuit when it is necessary to renew the fuses. Fittings are also supplied to allow either side of the circuit to be earthed when it has to be worked on, thus also giving complete security under these conditions. In accordance with the firm's standard practice, all the joints are made so that the apparatus is suitable for outdoor or indoor use. As will be gathered from Fig. 11, the self-aligning fuses are mounted on the underside of the lid, and the jaws are in the oil-filled tank. The lid is opened and closed by means of a wooden handle which is inserted into a socket, and is secured in position by clamping wing nuts. The combination of a spring and dashpot for ensuring freedom from mechanical shock when opening and closing the lid is a feature to which the makers direct particular attention, for the lid may be allowed to fall from its highest point without the slightest risk. By means of a plug, the oil tank can be drained and samples of the oil may be taken when desired. A drip shelf just under the hinges of the lid catches any small quantities of oil that may run down from the lid when it is opened, and a small tap is provided for draining this shelf. The particular switch fuse illustrated has a bus-bar for one side of the circuit, and a dividing-box for the other, but if dividing boxes are needed for the incoming and outgoing circuits, it is an easy matter to make provision for them. While the switch fuse exhibited is for circuits carrying currents up to 400 ampères and working at pressures up to 660 volts, the general principle is also used in apparatus for pressures of 3300, 6600, 12,000, 22,000 and 33,000 volts.

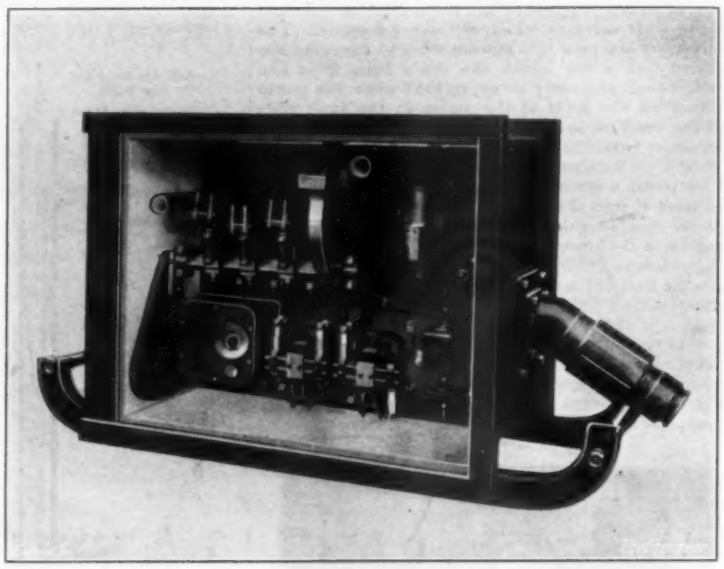


FIG. 8—GATE END STARTING BOX—METROVICK

With the object of affording the utmost reliability and convenience from an installation and maintenance viewpoint, the British Thomson-Houston Company, Ltd., of Rugby, has developed an entirely new line of reversing drum controllers for use with electric motors operating industrial equipments, such as cranes, hoists, &c. These controllers differ in construction from those hitherto manufactured, and incorporate special features which are based on the Company's long experience. The new controllers meet the requirements of slip-ring induction motors up to 75 horse-power and 550 volts, and direct-current motors up to 120 horse-power and 550 volts. As the same features are common to both types of controllers, the design can be well described by reference to one type; for example, a direct-current controller. The frame consists of separate top and bottom castings fixed together by means of square section steel bars,

FIG. 10—400 AMPERE SWITCH—REYROLLE

* No. I. appeared February 25th

whilst the back and front covers are of sheet iron, and both are detachable. The side projections on the back cover are so small that they do not prevent easy access to the working parts, so that when the front cover is removed by the release of four spring catches, the whole of the inside of the controller is accessible. A direct-current controller with front cover removed is shown in Fig. 12. As the back cover is separate from the frame, it can be removed for such operations as drilling for conduit connections. The body of the drum consists of ribbed castings carrying the copper contact segments with their

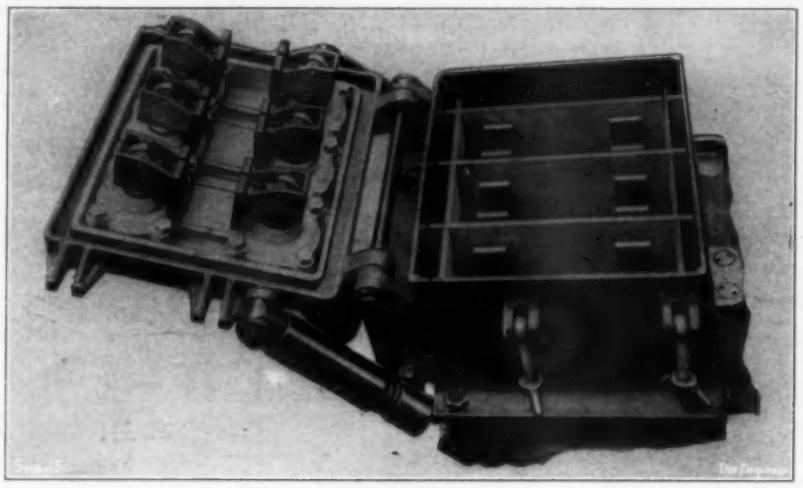


FIG. 11—400 AMPERE SWITCH REMOVED FROM STAND—REYROLLE

renewable arcing tips, and all the segments are of the same diameter. The star wheel, which is securely fixed to the top of the cylinder, is designed to give positive notching at each starting point, and the pawl is fitted with a large roller and roller pin to obtain a maximum wearing surface. The pawl spring, which is in compression, is quite accessible and easily removed. All the contact fingers are built up from heavy extruded sections. The fixed part, or finger base, is clamped on four sides of a mica-insulated square steel bar, and the moving part is attached to the fixed part by a pivot screw of large diameter, and

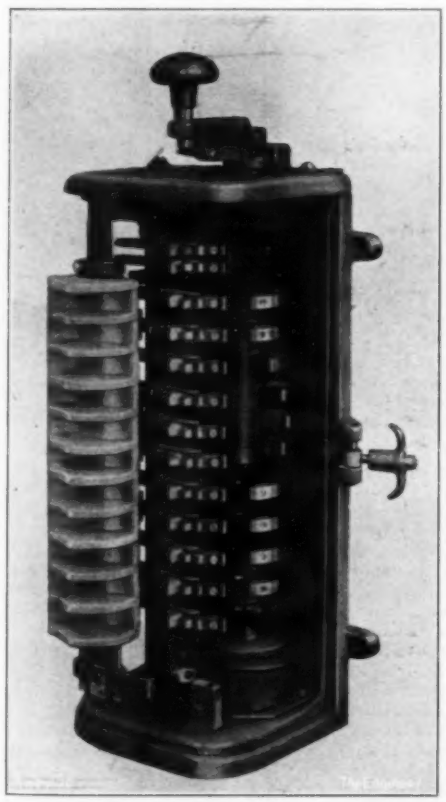


FIG. 12—D.C. CONTROLLER—B.T.H.

wide wearing surface. A heavy section renewable tip is fitted, and adjustment of the tip in relation to the segments on the cylinder is effected by means of a screw which operates on an extension of the finger arm. This screw is adjustable to one-sixth of a turn, and is automatically locked in position. The arrangements are shown in Fig. 14, which illustrates a medium-sized pivoted contact finger. Pressure of the finger on the segment is obtained by means of a compression spring, which is free to operate without friction on any part of the finger. The pivot is not

used for carrying current, for a flexible shunt is fitted between the moving and the fixed part, and as the shunt is entirely enclosed it cannot become accidentally damaged. The finger bar is mounted towards the front of the controller, and the screws for fixing the fingers to the insulated bar are accessible from the front or side. Any finger can be removed from the bar in a simple manner without disturbing other parts or taking out the whole bar. The process merely consists in taking out the cable and removing the two screws which fix the finger to the bar.

Interlocking fingers are provided so that an electrical interlock exists between the controller and a protective circuit breaker, with the result that in the event of the circuit breaker tripping, it cannot be reset unless the controller is in the "off" position. These interlocking fingers and those used in conjunction with shunt limit switches, are of robust design, and are mounted at the top of the controller on the main finger bar. The fingers are of the same type as the main fingers, and as the interlock segments are of the same diameter as the main segments, the drum can be withdrawn after removal of the cap plate, without fouling the interlocking fingers.

Fireproof arc deflectors are provided between the contacts so as to prevent cross-arcing. The portion of the deflector which acts as a barrier between each finger is moulded in one piece with the portion which is shaped to slip over and enclose the pole piece of the magnetic blow-out. The construction of these barriers is exceptionally strong, and as screws are not used for fixing there is no possibility of the barriers working loose. In order to facilitate inspection and cleaning, the assembled arc deflector is hinged, so as to swing clear of the fingers.

A new type of crank handle with an automatic "off" position latch is fitted as standard, the function of a latch in the "off" position being to prevent the handle from being accidentally knocked into a running position. If desired, all the controllers can be fitted with lever mechanism having either a vertical or horizontal "off" position; or alternatively, a rope wheel can be fitted in the smaller sizes, and a spring return mechanism can also be provided. The space allowed for cables in these controllers is approximately five times as large as that hitherto provided, this large cable space being obtained by the arrangement of the finger bar towards the front of the controller, as previously described.

For use with the drum type controllers described, as well as with other forms of control gear, the British Thomson-Houston Company has recently introduced a new type of light, unbreakable resistance, in which the grids are so graded that the appreciable temperature-resistance coefficient usually associated with all unbreakable resistances does not adversely affect the electric motors or equipment with which they are used. If specially required, grids can be supplied with practically a zero temperature-resistance coefficient. The resistance is composed of a continuous length of resistance strip, machine-formed into grids, and

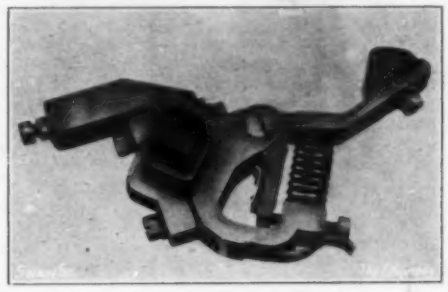


FIG. 14—PIVOTED CONTACT FINGER

in the complete resistance section there are no joints between the two external terminals. A typical unbreakable resistance of this type, with covers removed to show the grids, is illustrated in Fig. 13. High-resistance steel strip, heavily plated with zinc to render it rustless, is generally used, but in some cases another rustless material may be employed for the smaller sizes. Resistances can be supplied in any of the combinations already adopted for cast grids. For crane service each bank is mounted in a separate box, consisting of two pressed steel end frames which are flanged so that any number of boxes up to six may be bolted together to form a self-contained unit. The grids are supported between the end frames by four mica-insulated steel bolts, adjacent grids being insulated from one another by mica washers between steel washers.

Even under the most severe operating conditions, there is said to be no chance of the grids touching. Another notable feature is the method adopted for mounting the terminals so as to ensure good contact

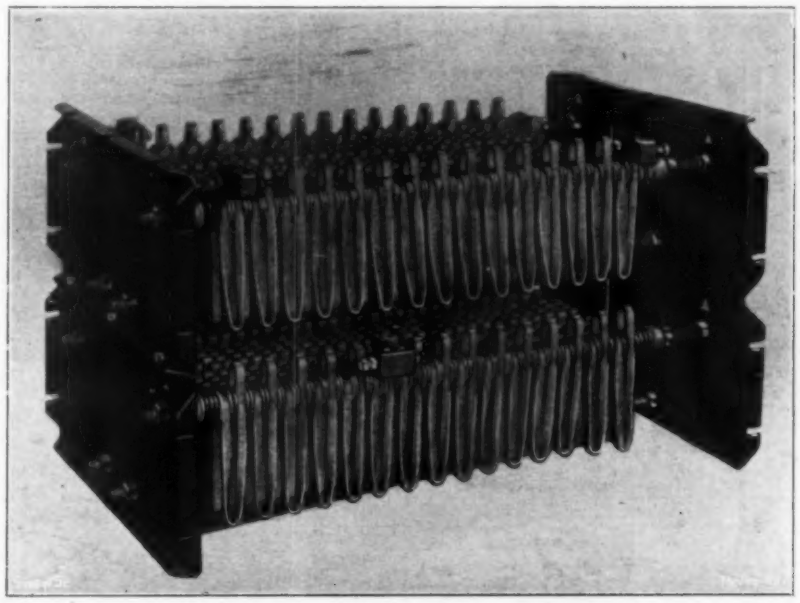


FIG. 13—UNBREAKABLE RESISTANCE—B.T.H.

between terminals and the resistance and also a rigid support for the incoming cable. For all units up to approximately 200 ampères (five-minute rating), the terminals are of extruded brass section and are bolted to a loop in the grid immediately above one of the insulated bolts.

Electric trucks of several types were shown by Wingrove and Rogers, Ltd. (British Electric Vehicles), of Mill-lane, Old Swan, Liverpool, including the Midget Whippet truck shown in Fig. 15. This truck has been designed to turn out of a 4ft. gangway into a gangway of the same width without any manœuvring, and it will run at about 6 miles per hour. About four units are required to charge the battery, the cost of power being approximately 6d. per day. The truck is small enough to go into a lift, and it is claimed that a boy or girl can drive it. When the

driver steps off the driving platform the power is cut off and the brake is applied.

The Mawdsley binary electric welder, constructed under Mr. F. Creedy's patents, was one of the principal exhibits on the stand of Mawdsley's, Ltd., of Dursley, Glos. The binary converter used for welding transforms from single or polyphase alternating current to direct current at suitable voltage for welding. On open circuit the direct-current

FIG. 15—ELECTRIC TRUCK—WINGROVE AND ROGERS

voltage varies from 60 to 70, according to the adjustment of the field and drops to from 20 to 30 at full load. The converter is made in two types, *i.e.*, horizontal and vertical, and in two sizes, rated at 30 volts 150 ampères and 30 volts 200 ampères. As is well known, the binary converter does not consist of two machines, but of a single machine, which transforms from alternating current to direct current—a form of construction that results in low first cost,

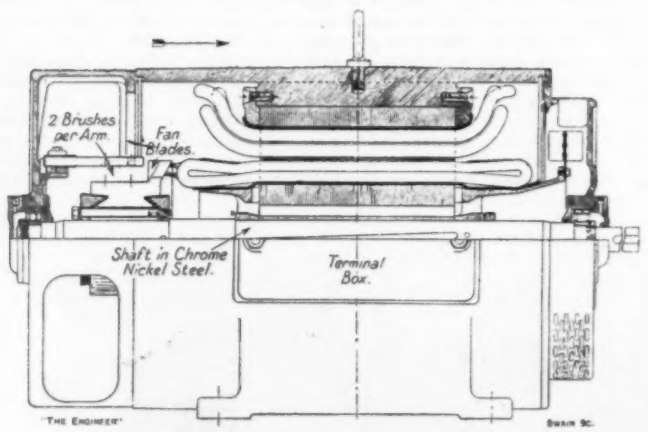


FIG. 16—BINARY CONVERTER—MAWDSLEY'S

light weight and small size, and adds materially to the efficiency, the power factor of the machine being equal to that of the best induction motors. As will be gathered from the sectional elevation, Fig. 16, the machine consists of a laminated stator similar to that of an induction motor and containing two windings, one connected to the alternating-current mains and constructed like that of an induction motor, and a second winding which forms the field winding of a direct-current machine. Inside this laminated stator

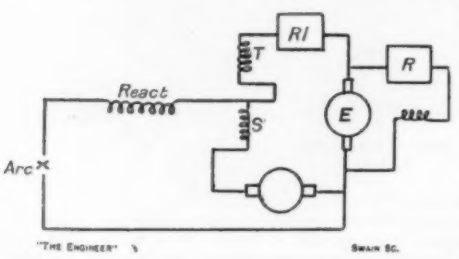
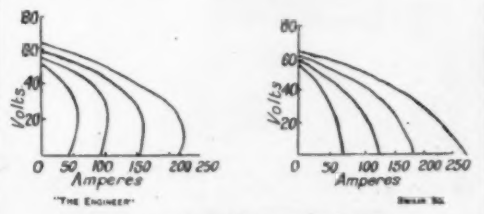


FIG. 17—CONNECTIONS FOR BINARY CONVERTER

revolves a rotor similar to that of a direct-current machine and fitted with a commutator as shown. The alternating-current winding is arranged for two poles and the direct-current field and armature windings for six poles, the armature being fitted with a number of equaliser connecting segments differing in position by one-third of the circumference. In order to obtain the characteristics which are required by the welding dynamo, the field windings are arranged in the manner shown in Fig. 17, where there is a shunt coil T and a reverse series coil S. The machine is fitted with a direct-coupled exciter E and the shunt coil is connected across the main commutators in series. Thus if E_1 is the voltage across the main commutator and E_2 that across the exciter, the current in the shunt coil will be

$$\frac{E_1 + E_2}{r} = \frac{E_1}{r} + \frac{E_2}{r}$$

Thus the current in the shunt coil may be regarded as being made up of two currents, one produced by the main voltage and the other by the exciter voltage. This is equivalent to the shunt and separately excited coils usually employed in welding dynamos, but it offers the advantage that fewer turns and larger wires can be employed and a consequent gain in reliability. The rheostat R 1 is used for varying the slope of the characteristic curve and is never adjusted during



FIGS. 18 AND 19—CHARACTERISTIC CURVES

ordinary operation. Regulation is effected solely by the exciter field, the whole of the adjustment necessary for different sized electrodes being effected by turning the handle of the single rheostat R. Each position of the rheostat results in the welder operating with a nearly or quite constant welding current and there is one position of the rheostat for every size of electrode. It has been found, the makers state, that many welders that can operate satisfactorily between 100 and 200 ampères are very unsteady on low currents, but the machine under consideration will operate between the limits of 50 ampères or less and 200 ampères or more. In the design of the binary converter great care has been taken to ensure that the machine shall be as steady and as easy to operate on the lowest currents as it is on the highest current, and for that reason two tappings are provided on the series winding. With the aid of a single-pole two-way switch the tapping suitable for currents ranging from 50 to 100 ampères or the tapping suitable for currents of 100 to 200 ampères is brought into use, and the steadiness of operation is said to be the same, irrespective of the current. The binary welder is claimed, in fact, to give the same steadiness as that obtained with resistance welding, coupled with the high efficiency obtained with a machine with a drooping characteristic. The volt-ampère characteristics for a binary welder are shown in Figs. 18 and 19. The former shows a series of constant current characteristics in which the current remains the same from about 30 volts down to zero volts, which means that the current on short circuit is not greater than the welding current and that, therefore, the tendency to stick is very much reduced. Moreover, when the machine is adjusted to give constant current any increase in the length of the arc made by the welder involves a corresponding increase in the voltage without any change in the current. This adjustment offers the advantage of only requiring a single rheostat and a single control handle, but it is possible by providing a second regulator to give the welder a sloping volt-ampère characteristic so that the current falls off to any desired degree when the arc is lengthened. The particular advantage claimed for the binary welder with its adjustments to give a sloping volt-ampère characteristic is that all the characteristic curves are parallel to one another, so that doubling the length of the arc, for instance, results in a reduction of current in the same proportion, irrespective of whether the machine is welding with 50 ampères or 200 ampères. Perhaps the most valuable advantage claimed for the binary welder is that current rushes can be kept under strict control and matters can be arranged so that the relation between the volts and ampères remains the same no matter how rapidly the current varies. In other words, if the electrode accidentally touches the work, the instantaneous short-circuit current cannot much exceed the steady value.

In order to facilitate the changing of transformer tappings and to avoid the necessity for exposing the transformer to atmospheric conditions, it is now usual, particularly on outdoor units, to fit a tapping switch which can easily be operated from the outside of the tank. Such switches are not, however, intended to break the circuit under load, the transformer being first isolated from the current. The tapping switch shown in Fig. 20 was exhibited by the Hackbridge Electric Construction Company, of Hersham, Walton-on-Thames, and it has been designed for use on small transformers on which a cheap switch is essential. The transformer tappings are connected to terminals on the outside of the cylinder B, whilst the tapping switch contacts are mounted on the inside of this cylinder. Inside this outer cylinder a revolving cylinder A is mounted, and on this cylinder the contacts are mounted that connect the adjacent studs on the cylinder B, the complete switch being mounted directly under the lid of the transformer so that it does not necessitate any increase in the size of the tank and consequent need for extra oil. A locking device is fitted on the hand wheel so that once the adjustment has been made the switch can be positively locked in that position until such times as it may be necessary to adjust it again. The drawing illustrates a three-phase tapping switch, but the same design is applicable to single-phase units.

The oil switch shown in Figs. 21 and 22 marks a distinct departure from all previous designs of the Park Royal Engineering Company, of Park Royal, London, N.W. 10, inasmuch as it is built upon the unit prin-

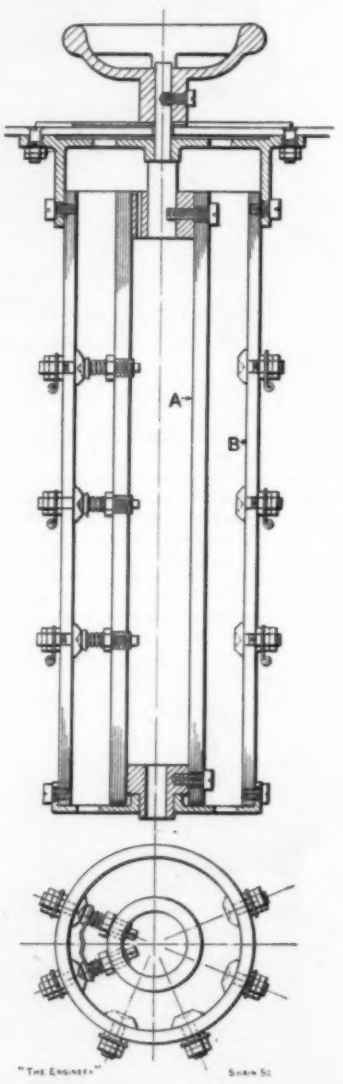


FIG. 20—TAPPING SWITCH—HACKBRIDGE COMPANY

ciple, with the mechanism under the switch hood and a countershaft in front of the switch, well below the terminals. Each of these triple-pole switches comprises three single-pole units, mounted together on a common channel base with the unit shafts coupled together by means of a floating coupling which compensates for any variation of alignment of the phases. The couplings are driven directly by the countershaft by means of a powerful toggle, which is driven in turn by means of the handle mechanism mounted in front of the centre phase, the operating mechanism being of the usual loose handle type, with a 180 deg. throw in the downward direction, and by means of an internal toggle the power is concentrated at the end of the stroke, where great leverage is necessary to close the contacts. By these means the operation of closing the switch is made easy. An indicator fitted to the front of the switch shows whether the switch is on or off. A separate welded steel tank is provided for each phase and the tanks are lined with impregnated maple wood, which is arranged so that a layer of oil is maintained around the sides of the tank, this layer being of sufficient thickness to withstand the full working pressure. Packing is fitted round the top of each tank in order to prevent leakage of the hot gas of the switch into the switch cubicles, which are arranged as shown in Fig. 22. Vent pipes are fixed to each main frame to conduct the gases to the outside of the switch chamber, and they are fitted with baffle plates to cool the gases

before they are discharged into the air and also to prevent oil being thrown out when the switch opens under heavy short-circuit conditions. The fixed contacts are carried on porcelain insulators cemented into iron clamps which are bolted in turn to the substantial dome-shaped main casting of the unit. The contact fingers are of the usual laminated controller type and they are fitted on the insulators in such a manner

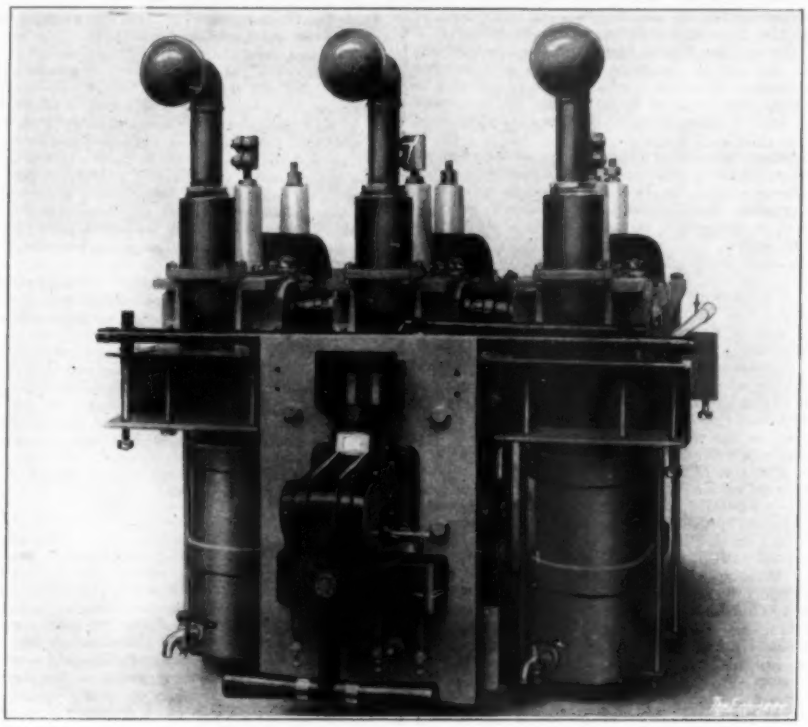


FIG. 21—THREE-PHASE OIL SWITCH—PARK ROYAL CO.

that they cannot possibly turn. The moving contacts are fitted in clamps which travel upon guide rods, which, whilst giving a perfectly straight-line motion to the contacts, also ensure proper alignment with the fixed contacts. The blades are insulated from the clamps by means of moulded material having sufficient thickness to withstand several times the working voltage, the clamps being attached to the mechanism

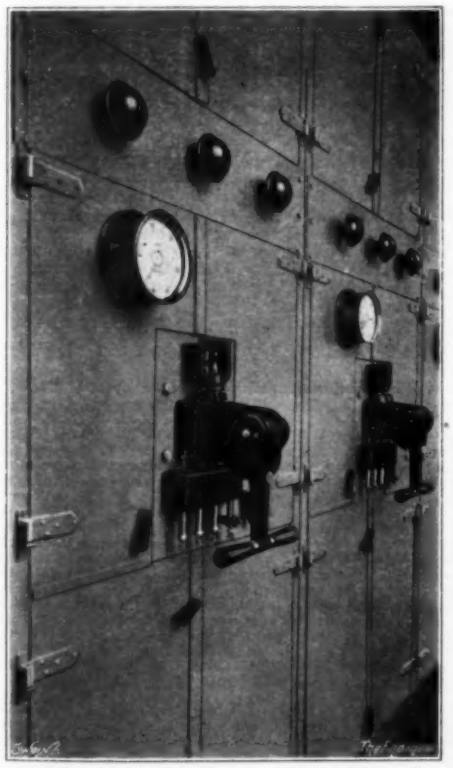


FIG. 22—THREE-PHASE SWITCHGEAR—PARK ROYAL CO.

by means of mild steel links. No wood is used in the switches, apart from that employed for lining the tanks. Each single-phase unit is fitted with steel springs, which are compressed during the closing operation, thus providing a strong accelerating force when opening. An oil dashpot is also fitted in each unit and it comes into operation at the end of the stroke and relieves the mechanism from shock. The makers' standard drum type auxiliary switches for shunt coil circuits, &c., are fitted behind the escutcheon plate and driven directly by the main countershaft, thus ensuring correct operation. An alarm bell switch can also be fitted. The switch is suitable for electrical operation, but in this case the handle-closing mechanism is, of course, replaced by a solenoid-operated mechanism designed to give a high initial pull. The capacity of the switch is 200–400 ampères at 11,000 volts and 600 ampères at 6600 volts, the rupturing capacity being 150,000 kilovolt-ampères.

The General Electric Company's exhibits were of an extensive and more or less representative character, but it is obvious that a firm engaged in the manufacture of practically every class of electrical plant and apparatus and small accessories cannot do more than show a few of its products. The stand was divided into four main sections, devoted to valves and lamps, household electric appliances, small electrical appliances and telephones, while the larger and heavier work of the company was represented by photographs.

To its wide range of ironclad switchgear the company has recently added the "D.B. Minor" double-pole switch shown in Fig. 23, the switch being mounted in a cast iron case with external fixing lugs. It is suitable for a current of 10 ampères at 500 volts or 15 ampères at 250 volts and may be used on direct or alternating-current circuits. The switch has been specially designed to meet the increasing demand for inexpensive but efficient switchgear suitable for lighting and heating house service circuits, and also on small power circuits in factories, workshops, &c. By inserting a gasket in the lid the switch can be made weatherproof. A positive quick-make-and-break action is controlled by a non-corrosive spring, which is only in compression during the time the switch is in operation. The switch blades are composed of hard-drawn high-conductivity copper and they are firmly secured to a square section steel coupling bar, which is insulated throughout its length by bakelite. The fixed contact blocks, which are composed of brass, have two clamping screws and phosphor-bronze side pressure wings, all parts being well proportioned to carry the current with which they have to deal. The fuse carriers are fitted with heavy section brass blades which engage with brass contact blocks having phosphor-bronze side-pressure wings. The fuse wire passes through an asbestos tube fixed in the body of the holder, and when in position it is situated low down in the deep arcing chamber in the base. At the top and bottom of the case there are cable inlets which are bushed with wood. In all respects the switch complies with the Home Office regulations.

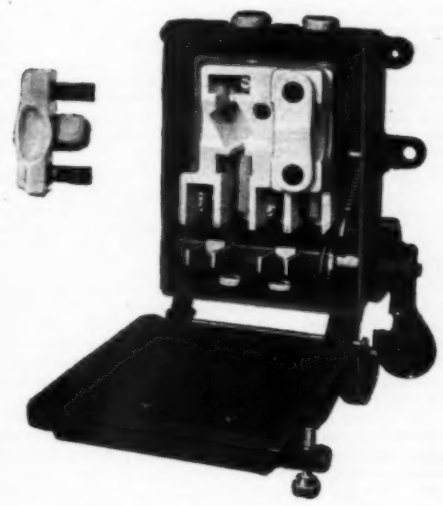


FIG. 23—DOUBLE-POLE SWITCH—G.E.C.

In order to eliminate the water supply necessary for the well-known "Electroflo" water-driven CO_2

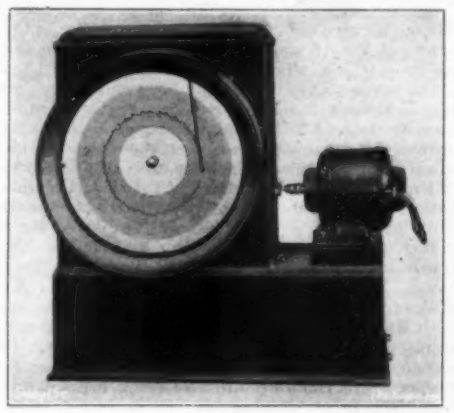


FIG. 24—CO_2 RECORDER—ELECTROFLO

indicators and recorders, a new motor-driven CO_2 recorder has been developed by Electroflo Meters, Ltd., of Abbey-road Works, Park Royal, N.W. 10. The instrument, which is shown in Figs. 24 and 25, gives a continuous line record of the CO_2 content, and has been designed on very substantial lines, the use of glass and other fragile materials having been avoided. The operation of changing the potash is a very simple matter, and all the parts of the instrument are very accessible. All steel pinions, gears and worms are hardened and polished, and in order to reduce vibration and noise, bakelite or fibre gears are used where necessary. As all the gears and moving parts are immersed in oil, they are at all times efficiently lubricated. The method of installing the instrument is shown in Fig. 25. The gases are drawn from the furnace through brass tubing immersed in oil by means of a pump producing a suction of from 8in. to 12in. of mercury. In passing through the pump the gas is divided into very fine particles, and as it comes

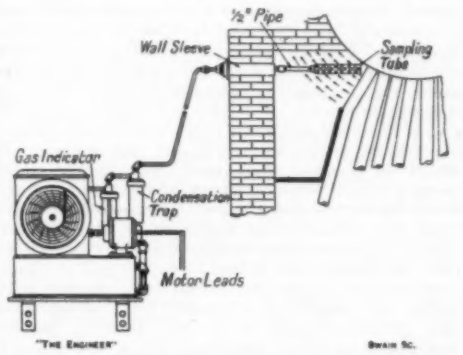


FIG. 25—METHOD OF INSTALLING CO_2 RECORDER

into close contact with the metal it acquires the temperature of the pump and the surrounding oil. It then passes into the measuring chamber, which is also immersed in the oil and the gas is measured at a specific temperature. The gas cylinder is raised by means of a bell crank and gears driven by the motor, and a definite volume of the gas in the chamber is sealed off. The gas then bubbles through the potash solution under the baffle plates, and rises to the surface, thus causing the absorption of all the CO_2 contained in the gas. The residual gas then passes into the final measuring chamber, which is also immersed in the oil surrounding the pump, and the primary measuring chamber. The oil chamber is directly above and is in contact with the potash chamber, so that the oil and potash are at the same temperature. If there should be a difference of temperature between the oil and potash, it is corrected in the final measuring chamber, which is also surrounded by the oil, so that there is no possibility of error due to temperature irregularities.

The pen mechanism is mounted on a bracket carried on the front of the case and a friction wheel is carried on the main pen staff. Directly over this is a retainer

which holds the pen in position, after the sample of gas has been registered. When it becomes necessary to renew the solution, the contents of the caustic chamber are easily drained off by the removal of the potash drain plug, after which the chamber is flushed with clean water and allowed to drain. The level of the potash tank is maintained by an overflow tube. The principal advantages claimed for the instrument are:—(1) Complete elimination of a water supply. (2) The entire mechanism is entirely submerged in oil. (3) The caustic tank has a capacity of 3 gallons, and one charge of solution is sufficient for from four to six months. (4) Minimum time lag and as a result of the large volume of gas drawn into the instrument the record made is true of the furnace conditions at the moment of inspection. The time taken for the complete cycle of operations is only 1 min. 40 sec. (5) No valves are employed. (6) The cost of upkeep is negligible; and (7) the current consumed by the motor is so small that it is of no consequence.

Special magnetic alloys known as Mumetal and Rhometal were exhibited by the Gutta Percha Company, of Wharf-road, City-road, N. 1. Mumetal is an alloy which, when suitably heat treated, has an initial permeability of between 5000 and 10,000, very low hysteresis loss, and a correspondingly minute coercive force. These unique properties have been utilised in the manufacture of continuously loaded high-speed submarine telegraph cables, and in the new section of the Pacific cable from Bamfield (British Columbia) to the Fanning Islands—the longest length of submarine cable in the world—Mumetal was employed for the inductive loading, with the result that signals can be transmitted about six times faster than in the old cable. Magnetic shields designed by Professor A. V. Hill, of the London University, have also been made with Mumetal, with a shielding power several hundred times greater than that obtainable with the best dynamo iron. The magnetic and electrical shielding properties of the alloy are also being utilised in the manufacture of watches for use in power stations and other places where electrical disturbances might vitiate the accuracy. Moreover, current transformers with Mumetal laminations have proved to be very efficient; and in the manufacture of distortionless radio transformers Mumetal laminations are also gradually being utilised.

To meet requirements the electrical resistance of the alloy can be varied between 22 and 70 microhms per cubic centimetre. To meet those special cases in which lower magnetic permeabilities in weak fields are required the alloy called Rhometal has been produced and it has a very high electrical resistance. The properties of Mumetal and Rhometal are produced by heat treatment, which is carried out as near the final manufacturing operation as possible for the reason that the magnetic properties are likely to be damaged by such work as punching, stamping, bending, &c. Mumetal and Rhometal can be supplied in the form of wire of all gauges, strip from ·003in. thick and upwards, sheet from ·006in. thick and upwards, and 4in. and 24in. wide. They can also be supplied in the form of bars, rods or castings. Wires, ribbon and castings made from a nickel-chromium alloy called Pyromic were also shown. With the development of electric resistance furnaces a demand for alloys with pronounced heat resistant properties has become insistent. Usually alloys of nickel and chromium are employed, and those containing about 20 per cent. chromium and the remainder mainly nickel have been specially favoured. A careful analysis of commercial grades of nickel-chrome is said to reveal the presence of elements which do not in any way enhance the life of the material at elevated temperatures, carbon being a very common impurity, which may be present either by accident or design. After careful research work the metallurgical engineers of the Telegraph Construction and Maintenance Company have found that the pure binary alloys of nickel and chromium containing no impurities, except those present in the purest raw materials available (viz., Mond nickel and chromium reduced by the Thermit process), could be successfully converted into sound ingots by a minute addition of a killing agent, the percentage of which, retained by the ingot, being only ·01 to ·02 per cent. and the nickel-chromium alloys manufactured by the Telegraph Construction and Maintenance Company, Ltd., are claimed to be the purest that can be obtained.

To meet the demand for a material with a higher specific resistance, experiments were made with a view to finding a third element which would increase this electrical characteristic without impairing the heat-resistant properties of the alloy, and eventually a ternary alloy was produced with a higher electrical resistance and a greater resistance to oxidation at elevated temperatures than the purest binary alloy of nickel and chromium, and this new material has been called Pyromic. It is a nickel-chrome alloy free from carbon, iron, manganese, silicon and aluminium; that is to say, it is free from elements usually introduced either as impurities or for the purpose of increasing the electrical resistance. Pyromic can be supplied in the form of wire of all gauges or in the form of strip or tape or rods and bars, the electrical resistance being guaranteed to be not less than 100 microhms per cubic centimetre.

LONG DISTANCE GAS TRANSMISSION.

In our issue of February 18th last, we reprinted a report on long distance gas transmission made by the British Consul at Cologne to the Department of Overseas Trade. The Consul has now sent the following additional particulars.

It is reported, he says, that negotiations are in progress between the Leopold Mine and the Dessau Gas Company concerning a gas delivery contract. In view of the construction, at the Leopold Mine, of a distillation plant working on the system of the Kohlenveredlungs A.G. of Berlin, and the projected building of seven furnaces of the same type at the Minna-Anna Mine, a considerable quantity of gas will be available from the new process, and it is estimated that sixty cubic metres of gas will be produced from every ton of brown coal. Each furnace will have a daily consumption of 100 tons of brown coal per day.

Should further furnaces of this kind be constructed for the purpose of distilling oil from lignite, which it is stated would be cheaper than the Bergin method or any other hydration process, the Central German brown coal industry would in the future, be in as strong a position as the Ruhr coalfields.

A further step towards the inauguration of a distant supply of gas from the lignite deposits of Central Germany was taken at a meeting of representatives of the Central German brown coal industry, which was held at Leipzig in the early part of February, 1927. The plans discussed at that conference were in opposition to those of the A.G. für Kohlenverwertung, which proposes to supply gas to Berlin and Central Germany from the Western cokeries. It was held at the meeting that the Central German brown coal industry should preserve its independence in the matter of gas supply, as gas supplied from the Western cokeries would be too expensive. The latter, however, is, remarks the Consul, a matter of opinion.

The formation of a company was discussed at the conference, but no details are available as to its probable organisation and capital. It is certain, however, that the following firms are willing to lend their co-operation in such a proposal:—Ilse, the Niederlausitzer Kohlenwerke, Eintracht, Bubiag, Riebeck (I.G. Farben), Rositz (Deutsche Erdöl), Werschen-Weissenfels, Anhalter Kohlen, Braunschweigische Kohlen (Reichselektrowerke), Leopold Mine (A.E.G.), and Michel concern. A committee of the Central German brown coal industry is to draw up a programme on gas supply, for submission to the industry.

INSTITUTION OF MECHANICAL ENGINEERS.

BIRMINGHAM MEETING, 1927.

As already announced, the Summer Meeting of the Institution of Mechanical Engineers will be held in Birmingham, and will begin on Monday, June 27th. The meeting will include visits to Derby, Coventry, Leicester, Rugby and Wolverhampton. A local reception committee has been formed under the chairmanship of the Right Hon. the Lord Mayor of Birmingham (Alderman A. H. James, C.B.E., J.P.), and includes members of the Institution, and other gentlemen residing in Birmingham and the Midlands. A ladies' committee will be established for the arrangement of the ladies' programme. Mr. John W. Hall (member) and Mr. George E. Folkes (associate member) have agreed to act as joint honorary local secretaries. The following provisional outline programme, which is subject to revision, has been arranged.

Tuesday, June 28th.—Morning: The Right Hon. the Lord Mayor of Birmingham and members of the local reception committee will receive and welcome the President, Sir Henry Fowler, K.B.E., LL.D., the Council and members of the Institution, with their ladies, in the Municipal Technical School, Suffolk-street. Reading and discussion of paper. Afternoon: Alternative visits to works and other places of interest in Birmingham. Evening: Institution dinner in the Grosvenor Room, Grand Hotel.

Wednesday, June 29th.—Morning: Alternative visits to either works in and around Birmingham or Wolverhampton. Afternoon: Alternative visits to works and other places of interest in and around Birmingham. Evening: Reception and dance at the Town Hall, by invitation of the Birmingham reception committee.

Thursday, June 30th.—Whole-day visit to Derby, by kind invitation of the London, Midland and Scottish Railway Company; visits to the railway company's locomotive and carriage and wagon works, and to other works in Derby; luncheon by invitation of the company.

Friday, July 1st.—Alternative whole-day visits to either Coventry or Leicester or Rugby.

The railway companies of Great Britain have agreed to issue reduced price railway tickets to Birmingham at a single fare and a third for the return journey from any station in Great Britain.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

THREE-CYLINDER LOCOMOTIVES.

SIR,—In view of present-day tendencies of locomotive design, I should like to add a little more to what I have already said in the columns of THE ENGINEER on this interesting subject.

It may be recalled that in the course of a controversy on "Compound Locomotives," I said I should very much like to see a three-cylinder simple 4–4–0 locomotive built for service in this country, as I considered such an engine would be superior to the splendid three-cylinder Midland type compound engines, from the standpoint of general all-round excellence—*vide* THE ENGINEER, August 28th, 1925.

I am very pleased indeed that Mr. H. N. Gresley has designed, and is now building, a series of such engines. I will not now state the many advantages of the three-cylinder simple system of locomotive propulsion as these are well known and are now generally recognised. It is worthy of note, however, that Mr. Gresley's new engine will have two excellent qualities that can be claimed for no other 4–4–0 locomotive in this country:—(1) A remarkably even torque, due to three high-pressure cylinders actuating cranks set at angles of 120 deg.; (2) a superior smoke-box action, due to six moderate blasts, in lieu of four strong blasts, per revolution, thus tending to more efficient combustion and better steaming.

These good features will be invaluable when hauling a train under adverse weather conditions.

It has often been claimed that "compound" engines have an advantage over "simples," in having a greater uniformity of piston-rod pull and thrust. Now, so far as steam pressure in the cylinder is concerned, this is so, owing, of course, to the later cut-offs rendered possible by compounding. It is well known, however, that piston pressure and crank pin pressure are not equal, save at the critical point in the stroke when the reciprocating masses cease, momentarily, to exercise their influence. Owing to the inertia of the reciprocating masses at the commencement of the stroke, crank pin pressure is less than piston pressure until the neutral point is reached, having passed which, crank pin pressure is greater than piston pressure, owing to the momentum of the masses.

It may possibly happen, therefore, that in a fast-running engine crank pin pressure may be practically uniform throughout the stroke, despite the great variation of steam pressure in the cylinder.

I have always contended that when a really powerful locomotive is required to combine efficiency and all-round economy, both as to cost of construction and upkeep, there is no better engine than a three-cylinder simple.

It is interesting to note that a new type of three-cylinder simple 4–6–0 locomotive will shortly make its appearance on another British railway.

CHAS. W. DAUNCEY.

Birmingham, February 28th.

A SPEED RECORD.

SIR,—In your issue of the 10th inst. you publish an interesting reference to the world's record set up by Captain Malcolm Campbell, on the 4th inst., of 174·224 miles per hour. You proceed to cast very serious doubts on the accuracy of the time of 20·663 seconds, basing your remarks on the statement that a stop watch could not give accuracy to the three places of decimals.

I quite agree that a stop watch could not give such accuracy, and it is for this reason that for some years attempts on world's records have been the subject of control by the Association Internationale des Automobile Clubs Reconnus. One of the conditions laid down is that the instrument used for timing the attempts shall be operated by the actual passage of the car.

The instrument which the R.A.C. uses to time such speeds contains two pens, beneath which passes a strip of telegraph paper. One pen is electrically deflected every half-second by a chronometer, having a special Kew certificate, with contacts in action, and the other pen is deflected by the passage of the car over two metal strips, which are kept separated by the inflation of a rubber tube. The half-second intervals on the paper strip are over an inch in length, and the incident marks of the front and rear wheels of the car are also quite clearly distinguishable. You will see from these two facts that the published time to three decimal places of a second is by no means hard to achieve.

HUGH H. GREGORY,
Head of Technical Department.

R.A.C., London, S.W. 1, February 21st.

"ENGINEERING WAGES: THEIR INFLUENCE ON MANUFACTURING COSTS."

SIR,—May I point out an error in the above article, as printed in your issue of February 18th, page 188, column 3?

I wrote: "Would it not be better to increase the hourly rate of these men permanently, which would give them a status," &c. As published, the word "ratefixers" was substituted for "these men."

Will you please insert this correction in your next issue?

February 28th. G. T. WILKINS.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: YORKSHIRE DISTRICT.—The district chairman, Mr. F. Marsden, city engineer, Bradford, is desirous of furthering the interest of the younger members of the profession in the activities of the Institution and particularly of the Yorkshire District. Towards this end he has kindly promised to give two prizes if there are sufficient entries for a competition. Essays for this competition are to be written on one of the following subjects:—(1) The Fixing of the Widths of Arterial Roads; (2) Sewerage Systems—with special reference to the run-off of Surface Waters, but not to include Sewage Disposal; (3) Road Surfaces for Different Conditions of Traffic:—(*a*) Materials; (*b*) Climatic conditions. If a sufficient number of entrants compete, the following prizes will be awarded: First prize, £2 2s.; second prize, £1 11s. 6d. Further particulars can be obtained from Mr. Percy Morris, hon. secretary of the Yorkshire District, Institution of Municipal and County Engineers, Town Hall, Wakefield.

PASSENGER BRAKE VANS.—A new type bogie passenger brake van, a hundred of which are being built on contract by the Birmingham Railway Carriage and Wagon Co., and the Metropolitan Carriage, Wagon and Finance Co., Ltd., has just been placed in traffic on the London, Midland and Scottish Railway. The vans are of steel construction, the bogies being of standard type, and the bogie frames are composed of rolled sectional steel bars. The body and underframe are combined to form a tubular girder as in the new steel vestibule cars. There are no partitions to give stiffness to the structure, and deep tie beams have been added for this purpose to reinforce the ordinary roof sticks. The framing generally is of pressed steel; the guard's "projection" or "look-out" is pressed in one piece; the roof sheeting is of No. 14 gauge, and the sides and ends of No. 11 gauge mild steel plate. Air is allowed to circulate freely round the framing, but no special insulation is provided. The vehicles will carry a load of 8 tons equally distributed, and the tare weight is 28 tons. There are four sets of double doors for luggage and two guard's doors opening inside.

Railway Matters.

A VERY versatile American civil engineer died recently. We refer to Colonel H. G. Prout. He served in the Civil War and was four and a-half years in the service of the Khedive of Egypt, where, as Prout Pasha, he was Governor of the Equatorial Provinces. Returning to America, he was appointed editor of the *Railroad Gazette*, which position he resigned to join the Westinghouse interests, and he was an adviser to Mr. Westinghouse until the latter died. Since then his only literary work of note has been the biography of Mr. Westinghouse.

INCLUDED in the estimate of expenditure on capital account during the present year the London, Midland and Scottish shows that it is intended to spend £84,000 on the supply of electricity to the London, Tilbury and Southend section, £32,000 on locomotives, £777,000 on carriages and £114,000 on wagons. The sum of £155,000 is to be spent on manufacturing and repairing plant in locomotive workshops, £147,000 in carriage and wagon workshops, and £38,000 in permanent way workshops. On road motors for goods and parcels work £61,000 is to be expended.

THE station at Penistone is jointly owned by the London and North-Eastern and London, Midland and Scottish companies, as successors to the Great Central and Lancashire and Yorkshire. The trains of the latter arrive from Bradford, Huddersfield, &c., and reverse at Penistone. On Sunday evening last the engine that brought in the 4.55 from Huddersfield had been to the turntable to turn and came out on to the up main line ready to go to its coaches and to form the 7.25 out. Whilst standing there, it was evidently overlooked by the signalman, who lowered his signals for the 5.35 p.m. express from Manchester to London. In the consequent collision several people were hurt, but none, except the driver of the light engine, seriously.

THE shutting down of the Buxton and Ashby light railway reminds us that the line was about to be built by a private company, but the Midland Railway Company successfully opposed the proposal when it came before the Light Railway Commission in 1902. The ground of opposition was that it would compete with an existing railway, and in dismissing the application the Light Railway Commission said they did so with the greatest regret, as they recognised that in the numerous cases that had come before them, the public need had never been more thoroughly demonstrated. The Midland Company subsequently built the line, which now has had to be closed because, owing to motor omnibus competition, it does not pay.

WE often have had occasion, when cases have been reported of trains running into motor cars at the level crossings of roads over railways, to point out that usually they occur where the crossings are not of public roads, but of private roads—known as occupation or accommodation crossings. Such an instance was that at Northumberland Park Station near Tottenham on February 16th, when an express ran into a motor lorry, and the driver of the latter was killed. The roadway was from the Tottenham Gas Company's works to a clinker dump. The coroner told the jury that the railway company had nothing to do with the guarding and supervision of the crossing, and he believed that the gas company had no statutory obligation.

THE Railway Rates Tribunal has just experienced, for the first time, we believe, a reversal of one of its judgments. The Court of Appeal on February 21st allowed the appeal of the Manchester Ship Canal Company and the Docks and Harbour Authorities Association against the decision of the Tribunal that "docks" consisted of the water spaces, quays, pontoons, &c., and that, in effect, they did not include warehouses. To appreciate the point, we would observe that under Sec. 58 (4) of the Railways Act the Tribunal had—to use the language of a layman—to see that in ancillary services like docks the companies made adequate charges. If, then, warehouses were not part of railway-owned "docks," the railway companies could undercharge the privately owned docks. This reversal of the judgment of the Tribunal might lead to a revision of a large number of the rates, but Lord Justice Bankes, in his judgment, said that Sir John Simon—for the Ship Canal—had relieved the Court of any necessity to consider that question, as the object of the appeal was to make it quite clear that on any further consideration of the questions involved, the Tribunal must not follow the present decision, but must deal with the questions afresh and on entirely different lines.

THE adjourned coroner's inquest into the Hull railway disaster of February 14th was resumed last Wednesday week. Whilst the railway company then admitted its liability for the accident, its cause has not yet been made clear. It may be remembered that in the notice of the disaster that appeared in our Seven-Day Journal on February 18th we said that one of the possible three causes was the premature restoration of a signal which would allow for certain points in advance of the signal to be moved before the train reached them. That possibility must not be lost sight of. It is already admitted that the signal protecting No. 95 points was restored in time for those points to be moved and, had that been done, the presence of the Scarborough train on the wrong line would be accounted for. But the signalman maintains that he did not move the point lever, and there is corroborative evidence that it was normal after the accident, and that, further, the points were undamaged. Hence, if moved, it must have been done between the restoration of the signal and the arrival of the engine at the points, and the lever must then have been put from the reversed position to normal after the train had passed through them and before it was noticed that it was going in the wrong direction. All that would have been smart work, but, being power operated, is quite possible. The only alternative was an extraneous electrical current that improperly moved the points, and, be it noted, moved them back again. As little evidence as to that feature of the case has been called, it would appear that that possibility is not being considered. The inquest now stands adjourned until the 16th inst.

Notes and Memoranda.

A REMARKABLE growth of motor transport in Southern Rhodesia is revealed by a detailed statement recently published. During 1926 a grand total of 4456 motor cars was registered in Southern Rhodesia, compared with 2322 two years ago. A total of 1313 motor cycles was registered in the Colony, as against 621 in 1924. It will thus be seen that the number of motor vehicles has practically doubled within two years. Salisbury District has 2207 motor vehicles; Bulawayo, 1993; Gwelo, 606; Gatooma, 398; Umtali, 261.

THE first factory for the manufacture of power alcohol on the Queensland sugar fields has now been opened. The first unit is attached to the Plane Creek sugar mill at Sarina, 26 miles south of Mackay, and plans are ready for the establishment of two additional factories in North Queensland. The spirit is made from molasses and cassava, and will be enriched with sulphuric ether, also produced at the factory, so that its value will be about 98½ per cent. that of petrol. It is expected to produce about 1,000,000 gallons of power alcohol in the first year of working.

ACCIDENTS at coal mines in the United States during the year 1926 resulted in the loss of 2510 lives, according to statistics compiled by the Bureau of Mines, Department of Commerce. The output of coal during the year was, it is estimated, 663,290,000 tons. Hence the fatality rate per million tons produced was 3·78, as compared with 3·84 for 1925. An examination of the principal causes of accidents in 1926 showed a very slight reduction in the death-rates per million tons from falls of roof and coal and for explosives, and a slight increase in the rates for haulage accidents and for gas and dust explosions. The rate for electricity remained unchanged.

THE two large electric generators, each nominally rated at 90,000 kilowatts at 90 per cent. power factor, which are being manufactured by the General Electric Company of America for the Southern California Edison Company, are stated to incorporate some unusual features of design. The armatures are being built with a very heavy construction so as to be gas-tight, with a view to the possible future adoption of a new system of hydrogen cooling. The machines will also be the first to combine a double-flow low-pressure end. Four vertical condensers are to be fitted, giving the advantage of a simplified foundation with increased space for removal of condenser tubes.

A NOVEL use for electric lighting, states the *Journal* of the American Institute of Electrical Engineers, is being employed in the cotton raising country of the south-west as a means of ridding the fields of the ravages of the cotton moth. It is understood that a cotton raiser near Tornillo, Texas, is using electric lights for this purpose on his farm. Lamps have been strung along each row of the plants and at night the light attracts countless insects which come in contact with the lamps and fall in the cans containing kerosene conveniently placed beneath each light. Thus the moths are exterminated before having a chance to lay the eggs from which are hatched the worms which are so disastrous to the cotton crop. A similar method has been used in the eastern states as a protection against the ravages of insects which feed on the foliage of peach trees.

LABORATORY experiments on the fracture of quartz by heat show that disintegration at the transformation point, 575 deg. Cent., gives granules and not splinters. Gentle pressure on a correctly heat-treated specimen gives thin laths of silky transparent quartz, often with finely toothed edges. Quartz from different sources gives varying results, and some specimens become fragile even when quenched from 300 deg. Only a few varieties will give the silky laths, which are the most friable form of quartz. A change in the dielectric constant is observed at as low a temperature as 340 deg., and the temperature at which disintegration begins varies over a range of 20 deg. It is suggested by Mr. Bernard W. Holman, in a paper recently given before the Institution of Mining and Metallurgy, that these results may have a bearing on the nature of the allotropy of quartz.

APART from the well-marked effects of light that are utilised in photo-electric cells, other instances of the impact of light giving rise to a more or less minute E.M.F. can be mentioned. It is known, for example, that in certain circumstances copper oxide shows this effect. It has also been recently reported by S. Schlioitch that a similar effect occurs in the case of a strip of platinum immersed in a liquid which does not attack it. Thus, with platinum in a solution of potassium chromate, or an aqueous solution of ammonia, a pressure of 12 milli-volts has been developed. The chief feature is that this pressure is developed without any battery being necessary—as is, for instance, necessary with the selenium cell. When a fluctuating light impinges on this platinum combination an intermittent current, which will cause a humming note in a telephone, is produced. Such effects seem to deserve attention from physicists. It is always possible that some photo-electric phenomenon might be discovered which might ultimately form the basis of the long-sought "physical photometer."

THE total hard coal production in Czechoslovakia during 1926 is officially stated to have amounted to 14,508,000 tons, against 12,754,000 tons in 1925, the increase amounting to over 13 per cent. The production of lignite did not register any increase, amounting in 1926 to 18,789,000 tons, as against 18,799,000 tons in 1925. Total exports of hard coal in 1926 amounted to 2,885,000 tons, compared with 1,430,000 tons in 1925. Exports of coke amounted to 489,000 tons—422,000 tons in 1925—and of lignite to 2,206,000 tons—2,071,000 tons in 1925. Exports to England were largest in September, when they were 130,000 tons, after which they constantly declined until in December they only reached 22,000 tons. Coal was also exported to Norway and Denmark. All these markets, however, were lost immediately after the strike, as the native product is not capable of competition with English coal, so that Czechoslovakia has to limit its exports to the old markets, namely, Germany, Austria and Hungary. The only exception perhaps was Italy, to which country 80,000 tons of coal were exported even in December, but there also keen competition is now being experienced from English, German, American and Polish coal.

Miscellanea.

A RICH lead ore deposit has recently been discovered west of Tachushan, Kiaochow; also at Tsian, Fengtien province, another lead mine has been discovered, and experts are to explore the mine with a view to further development.

THE Canada Steamship Lines, Ltd., has secured from the Toronto Harbour Commission, at the price of about 1,000,000 dollars, a site of 7 acres on the water front, on which new docks will be constructed, work being commenced immediately.

THE battleship Agamemnon, for some time target ship for the Atlantic Fleet, was towed away from Portsmouth on Tuesday, March 1st, to be broken up. She will be replaced by the Centurion, one of the vessels discarded under the Washington Agreement.

THE Government of the Federated Malay States announced at a recent meeting of the Federal Council at Kuala Lumpur that it proposes to import dredgers to undertake flood-prevention work in rivers. This proposal will entail a capital expenditure during the next few years of about £350,000, with an annual outlay of £87,500.

THE Royal Aero Club has officially entered three racing seaplanes for the Schneider Trophy contest, which is to be flown in Italian waters in September next. The machines, which are now under construction, are a Supermarine, a Gloster, and a machine to be built by Short Bros., with a new type air-cooled Bristol engine specially designed for this race.

AFTER prolonged consideration of the report of the Special Canals Committee which has been examining the possibilities of alternative water routes between Birmingham and the seaboard, the General Purposes Committee of the Birmingham City Council decided that the report be presented to the Council on March 1st with a recommendation that the whole question of acquiring and developing, or merely acquiring, existing canal routes be not proceeded with.

THE French mining regulations require that authorisation must be secured from the French Bureau of Mines for the use of electrical equipment underground in collieries. This has proved easy in the case of mines producing little gas, but quite impossible where they produce a great deal of gas. It is understood, however, that new regulations are now being formulated by the Bureau of Mines, and that they will be more liberal regarding the use of electrical equipment underground.

A STEEL arch, spanning the entire width of the Kill van Kull, rising to a height of 150ft. above high water level, and flanked by concrete arched viaducts on either side, is the type of bridge proposed by the Port of New York Authority to connect Bayonne, N.J., with Port Richmond, Staten Island. The span will be 1600ft. to 1700ft between haunches. The cost of the bridge, which will provide for six traffic lanes and for pedestrians, is estimated at less than 16,000,000 dollars.

THE Finnish State Explosives Factory, at Vihtavuori, which was erected to the plans and designs of the Köln-Rottweil A.-G., commenced the manufacture of gunpowder last March, and that of nitro-cellulose in July. In making the latter from Finnish cellulose, instead of cotton, a reduction of 23 per cent. in the amount of ether used has been rendered possible. Ether is made at the factory, but the nitric acid needed is imported. Plants are being erected for the recovery of the alcohol and ether.

A SPECIALISED trade exhibition, planned to demonstrate the economic value of modern power efficiency machinery and apparatus, is to be held in Manchester from June 22nd to July 2nd next. Although at exhibitions of engineering products there have been isolated displays of apparatus of the type referred to, it is claimed by the promoters of the forthcoming Power Efficiency Exhibition that it will be the first of its class. Applications for space should be made to Mr. Frank Nasmith, 121, Deansgate, Manchester.

THE Montreal Tramways Company has completed the installation of an automatic mercury-arc rectifier substation at Verdun, Quebec, which is the first of its kind in Canada. It is entirely automatic, requiring no attendants to keep it in operation, and, in it, alternating current at 12,600 volts is converted into a direct current at 600 volts by transformers and rectifiers. The cost of station and equipment was about 200,000 dollars, and the electrical equipment was supplied by Brown, Boveri et Cie., of Baden, Switzerland.

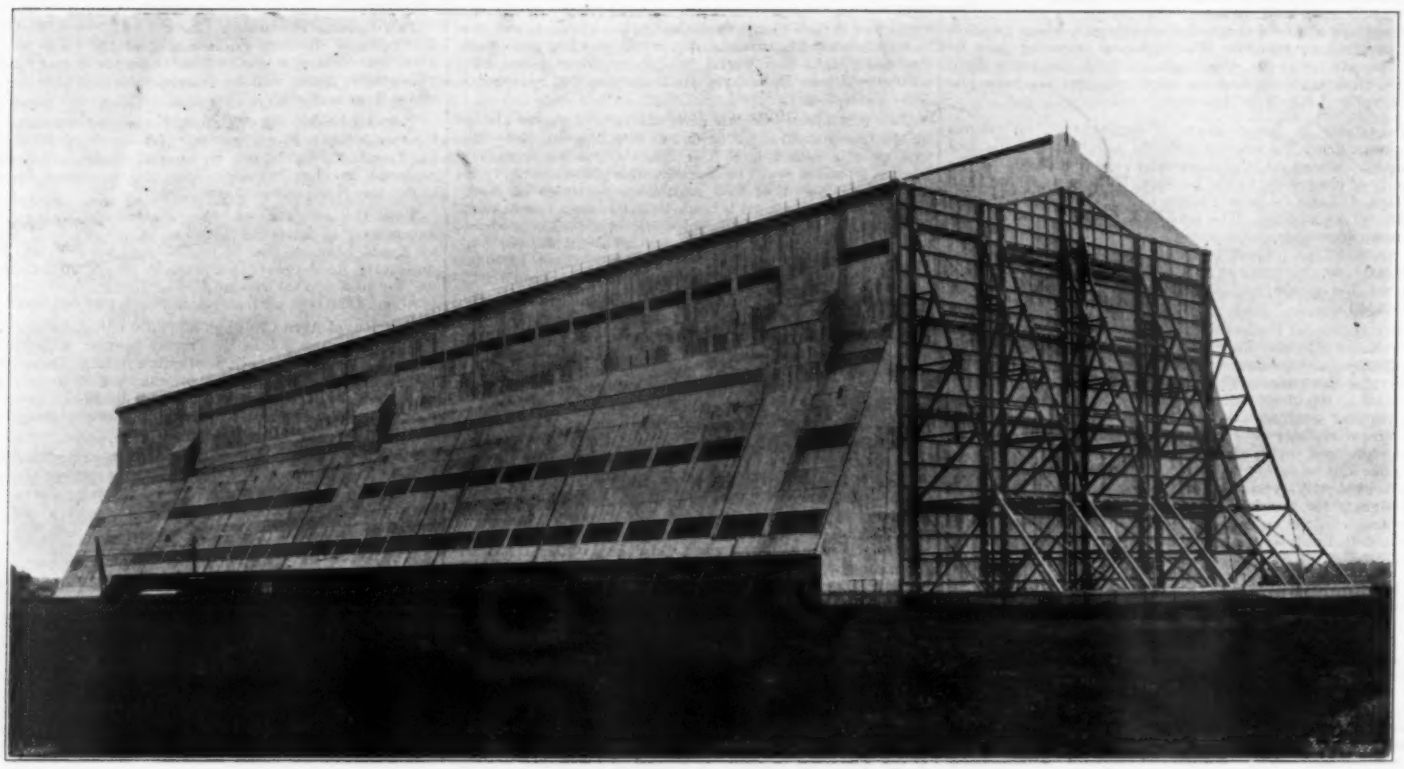
THE municipal authorities of Zurich have applied to the Aargau Cantonal authorities for a concession to utilise the water power of the Limmat River, near Weltingen. The scheme provides for the construction of a dam sufficient for minimum and maximum outputs of 14,000 and 25,000 kilowatts respectively. The local authorities of Scanfs, in the Engadine, have also applied for a concession to establish a hydro-electric plant near Taralp, at a point where it is estimated a minimum of 300,000 horse-power is available. A scheme is also reported to be under consideration for the establishment of a hydro-electric power station on the Lower Aare River, near Klingnau, the electricity from which would be "exported" to Wurtemberg.

A CONTRACT has been concluded between the Municipality of Montevideo and a syndicate holding the concession for the construction of the Rambla Sud (South Sea Wall). This enterprise has been under consideration for over eighteen years. The first concession was granted to a British company in 1909, but owing to so many radical alterations being subsequently insisted upon the works were abandoned. The final plans, which have now been approved by the Administrative Council, involve the expropriation of a considerable amount of private property. For its purchase the municipality has been authorised to issue a 7 per cent. loan not exceeding 9,000,000 dollars (£1,800,000). The construction will necessitate the demolition of a number of buildings, the sinking of submarine foundations and the building up of a wide stretch of retaining walls. A substantial proportion of the cost, estimated at 3,000,000 dollars, will be retrieved by the sale of frontages on the new thoroughfare. The work is expected to take at least six years.

THE RECONSTRUCTED AIRSHIP SHED AT CARDINGTON

THE CLEVELAND BRIDGE AND ENGINEERING COMPANY, LTD., DARLINGTON, ENGINEERS

(*For description see page* 230)



EXTERIOR—DOOR END

INTERIOR—CLOSED END

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EIGHT-PAGE SUPPLEMENT—THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM.

THE ENGINEER.

MARCH 4, 1927.

The British Locomotive and Foreign Inventors.

THE steam locomotive is essentially an English invention. We owe it to Trevithick, Stephenson Hackworth, Dodd, Bury and a dozen more men who did all the pioneer work upon it, and step by step, in the course of a relatively few years, brought it to a form which, in all countries of the world, it has retained ever since. Modifications have been made in design, special types for special purposes have been produced, the size and power have increased enormously, but still the horizontal, or but slightly inclined cylinders, the tubular boiler with the dropped fire-box, the exhaust to the chimney, the coupling-rods, and, above all, the direct drive on to internal or external crank pins, are just as they were when, by successive improvement, a type was reached, in the Planet of 1830, upon which no further radical change was found to be beneficial. If we place the real beginning of railway locomotion with Trevithick's engine of 1808, we have in this period of twenty-two years a succession of inventions of wholly incalculable value, the credit of which belongs without exception to English engineers. There is in mechanical engineering no more brilliant example than this of the rise of a machine from a very crude and imperfect, to a very perfect form, a form so fundamentally sound that no material departure from it has taken place in a hundred years. To the Stephensons most of the credit has been given, and by them it is deserved, not only because of their work on the locomotive itself, but because they, and particularly George, had a long vision of what railway communication would do; but there were many men, both on the mechanical and civil engineering sides, who contributed with astonishing courage, inventiveness and originality, to the success of railways, and we may claim every one of them as our own countryman.

Remembering this wonderful tradition, we cannot but regard with some sadness the change which seems to be taking place in British locomotive engineering. Science and technology know no national boundaries, and it was inevitable when British locomotives became familiar in foreign lands that the engineers of those countries should begin to modify them to suit their own conditions of use or manufacture, and to attack the problems which still remained from a new standpoint. But for many years British locomotive engineers, and particularly a long series of locomotive superintendents, provided a full share of the inventions, and Great Britain held her own. But what of recent years? Is the tale as good? Are the principal improvements emanating from this country, or from others? The answer is, alas, not wholly to our credit. Consider, for example, the foreign inventions that are now in use on British locomotives or are attracting the attention of British engineers. The Walschaerts valve gear came so long ago that its origin is almost forgotten; we may pass it by. But what of the Schmidt superheater, the Cartozzi axle-box, the Caprotti valve gear, the Lentz valve gear, feed-water heaters of foreign origin, an American "booster," the Ljungstrom turbine locomotive, and various special forms such as the Meyer and the Abt? It is not pleasant to contemplate these things. There is hardly a single one of them that could not have been first produced in this country. It sometimes happens that national conditions are at the root of inventions. Those inventions are not likely to be produced in any country, save that of their origin, but once produced they are found to have uses in other spheres. But there is no such defence in this case. There is no national reason why the Schmidt superheater should have been developed in Germany, nor why poppet valve gears should have emanated from Austria and Italy. They are just as beneficial in any other land as in the countries where they were first used. Indeed, the superheater may not unjustly be regarded as a development of a Trevithick invention, and poppet valve gears have been for so long in use in all parts of the world that the origin of them is practically lost. Watt used them, and that is enough for us. The value of the superheater is so well established that there is no need to dwell upon it, but the poppet valve gear is only, in Great Britain, at its beginning. For years and years engineers had struggled with the problem of the free exhaust in locomotives. They invented new gears, but never departed from the principle of the sliding valve. Yet stationary engine builders had been employing separate admission and exhaust valves for a generation or more. They solved the problem, but we left it to foreign inventors to show how the advantages could be secured in locomotive cylinders. We may discount the newspaper reports of the phenomenal saving effected by the Caprotti gear on a "Claughton" class engine, but the fact remains that an economy in steam consumption of something in the nature of 10 per cent. may fairly be expected. The Lentz gear should give the same figure, but so far it has attacked the problem with less thoroughness. It still retains the familiar motion, Walschaerts as a rule, to actuate the poppet valves. Now, there is, we assert, no reason why British engineers should follow either of these designs. They have lost the credit of introducing poppet valves on locomotives, but they may now work out their own solutions of the method of operating them. In mechanical engineering it very rarely happens that there is only one way of achieving a given object. The use of the imagination nearly always shows another, and frequently a better way. If our own people will settle down to the design of a motion that will at once get rid of all the reciprocating valve gear, give a constant exhaust and a variable admission, we have not the slightest doubt that they can do it.

If we ask ourselves why it is that British locomotive engineers are allowing themselves to be forestalled by foreigners, we find it difficult to give an answer. It is certainly not that our engineers are supine. The remarkable developments of engines as a whole, but on normal lines, disposes of that criticism. Mr. Gresley's three-cylinder, Mr. Maunsell's four-cylinder, Sir Henry Fowler's compounds—wonderfully economical engines—show steady advance. Is it, then, that tradition is engrained in all our designers through their upbringing? Perchance. Or is it that the need for absolute reliability with low maintenance costs has been so impressed upon them by the business side of railways that they lack the courage to make adventures? Or, finally, is it that directors are men of little vision and will not incur the expense of experiments? To the credit of engineers, we believe that the last named is a potent cause. Why is it that Russia and Canada can make progress with the development of the internal combustion locomotive, the future of which cannot be doubted, and not a single British railway has yet tried one on its lines, and is, even now, only timidly nibbling at the proposition? The answer is that the expense is too great. It is not that engineers are lacking—we refuse to believe that—but that they are hampered by men whose vision cannot extend beyond next year's dividend, and who cannot see the future which lies before railway locomotion. To both, to engineers and to directors, we would say that devoted as we are to the normal steam locomotive, we are convinced

that modifications of it are essential, and that its complete disappearance must be faced as a possibility. To be in the van of the progress that must take place, we must experiment and experiment, test and reject, test and reject, until the best alternative is found. For that money is needed, but given money we have no hesitation in saying that British engineers are as capable as any in the world of making the necessary advance, and far more capable than most.

An International Register of Aircraft.

THE announcement made at last week's annual meeting of the British Corporation for the Survey and Registry of Shipping, that it had agreed to join the shipping classification societies in France, Japan, Germany, America and Norway in a scheme aiming at the formation of an international register of aircraft, is, when its significance is properly understood, of importance to the British aeronautical industry alike from the political, commercial and technical points of view. Since the beginning of May, 1919, when civil aviation was first permitted in this country, until the present moment the registration authority for British aircraft has been the Government. Under the Air Navigation Act no aircraft may fly in this country unless it has been registered and bears its nationality marks, unless it is certified as being airworthy, and unless the pilot is licensed and possesses a certificate of competency. It is undoubtedly true that in the hands of the Air Ministry British aircraft standards have reached a level unsurpassed, some hold even unapproached, by those enforced in any other country. For the past five years all the work connected with the registration of French aircraft, aircraft engines and pilots has been undertaken by the Bureau Veritas, which, with the aid of a subsidy from the French Government, has added this work to its normal shipping activities. It was on the suggestion of the Bureau Veritas that the international registration scheme which has now been agreed to by the British Corporation and other classification societies was formulated. The essence of that scheme so far as it affects this country would seem to lie in the transfer to the British Corporation of the registration authority now exercised by the Air Ministry. It is stated—although we have been unable to confirm the report—that in principle the Air Ministry will welcome the possibility of such transference, but whether the aircraft industry and the public will also welcome it is a question which has yet to be answered.

It is, we think, to be feared that in this matter the supposed analogy between aircraft and shipping may be developed to an extent which the actual degree of similarity does not warrant. At present British civil flying on an organised scale exists by virtue of the liberal assistance in the matter of subsidy and other services accorded to it by the Government. One company, Imperial Airways, Ltd., has virtually a monopoly of the regular services so far as British aeroplanes are concerned, while of the two experimental airships to be used for commercial purposes which are now under construction in this country, one is being built and will be operated entirely, and the other largely, under the direct control of the Air Ministry. No such situation exists in the shipping industry. The Government is not directly interested in any commercial vessels or shipping company and what subsidies it pays are, properly regarded, disbursements for services received. In the shipping industry the joint system of registration and supervision exercised by the Board of Trade and the classification societies is tolerable because the shipping industry is commercially owned and operated. Joint control over the civil side of flying can hardly be envisaged as practicable, let alone advantageous, until the Government ceases to be considerably less involved in and responsible for the success of the industry than it is to-day. That joint control would prevail under the proposed scheme may, we suppose, be taken for granted. While the British Corporation may take over the registration, survey and certification of commercial aircraft and even the examination and certification of the operating *personnel*, it is not, we suppose, intended that the Government should cease to render those important services of a meteorological, navigational and terminal kind on which the success of the industry, such as it is, largely depends to-day. With a monopolistic company subsidised by the Government running the services, a private corporation responsible for the registration and airworthiness of the aircraft, and the Air Ministry in control of the meteorological and other essential departments, the position would be far from analogous with that of the shipping industry and would, we fear, even if found tolerable, be subversive of efficiency. It may be argued that the transference of certain of the powers at present exercised by the Air Ministry to a commercial corporation is a step in the desired direction of placing civil flying on an independent basis. To that argument it can be replied that there are still no signs that such independence is within nearer reach of attainment to-day than it was before Imperial Airways was established That company, even with the aid of the Government subsidy, finds it hard or impossible to earn an adequate financial return on its capital. There is not the slightest doubt that the public still hesitates to take civil flying seriously and continues to lack confidence in its certainty and safety. While the numbers using the organised air routes are not insignificant, they are composed, it has been confessed, largely of people who chose to fly for the sake of the novel experience. Those who travel by air regularly as a matter of business or convenience are in a very small minority. What confidence the public has in civil flying at present rests almost entirely on the knowledge that no machine is permitted to fly with passengers unless it and its pilot have passed a rigid and repeated Government examination in all matters affecting safety. The public's faith in the thoroughness of the Government's control and examination is more than justified. There is a grave possibility that it may be shaken and even for a time destroyed by a transference of some of the Government's responsibilities to a commercial organisation, however ably such a body may in reality execute its duties.

It is asserted that the proposed transference will not lower the present standard of British aircraft construction and that the institution of an international register of aircraft will still leave each nation free to classify machines according to its own scales. The suggestion seems to be made that if we act now we will have a chance of making the British registry of aircraft as supreme throughout the world as Lloyd's register is amongst the world's shipping. If in this possibility a good reason is to be found why we in this country should adopt the scheme, we may look on the reverse side of the picture to discover the reason why foreign organisations should express a desire for our co-operation. We hesitate to say that foreign organisations are anxious to see us lowering our aircraft standards but that we have given them abundant reason for so desiring there can be no doubt. The bulk of the cross-Channel passenger traffic is to-day attracted to British machines because it is known that accidents to them have been much fewer than those occurring to foreign machines and because it is suspected, not without cause, that the explanation is to be found in the acceptance of lower standards of construction and safe operation abroad than those imposed on British machines. How far the unnatural conditions of competition for air traffic would be found to permit a successful resistance on the part of a British commercial organisation, comprising aircraft builders, owners and underwriters, to the pressure of lower foreign standards we cannot at this stage venture to discuss. But of this we are convinced, that the assurance of a successful resistance to such pressure is much more definite and certain as things stand at present than it would be if the Air Ministry delegated to a private undertaking any of those supervisory functions which it has so far retained under its direct and undivided control. The precise details of the proposed international scheme have not yet been disclosed. They have indeed, or so we gather, still to be worked out. Until they are before us we cannot express a final opinion on the merits of the scheme. It may be that when they are revealed they will be found to be less upsetting to the established order of registration and control than our reading of the preliminary announcement has led us to anticipate.

The World's Future Supplies of Liquid Fuels.

By JOHN B. C. KERSHAW, F.I.C., F.S.S.

No. I.

THE position with regard to the world's future supplies of liquid fuel is one of great importance and interest at the moment, especially to chemical engineers. On the one hand, there has been a most extraordinarily rapid increase in the production and consumption of liquid fuels, especially of petrol and motor spirit, since the end of the war; and, on the other hand, there have been most contradictory estimates published concerning the probable life of the oilfields of the world and of the reserves of liquid fuel that are still available.

The statistics presented below, relating to oil production, are compiled from those contained in a paper which was contributed by K. G. Mackenzie, in September, 1925, to a symposium on motor fuels, arranged by the American Chemical Society in New York. The figures show that both the American and world production of fuel oil attained a maximum in 1923, and that the output has fallen away slightly from this high point in the two following years. The detailed figures are given in tabular form in Tables I. and II. and as they are expressed in thousands of barrels, they require to be multiplied by 42,000 in order to obtain the corresponding production in gallons. The more important of the figures, showing the production during the last eight years compared with the year 1913, have been thrown into the form of a diagram—Fig. 1. This graph indicates clearly the dominating position occupied by the American producers, in relation to the total world supply of liquid fuels. The proportion of the aggregate output drawn from the American oilfields in 1913 was 64·7 per cent., and although in 1921 it declined to 61·6 per cent., in 1923 and 1924 it had risen to over 70 per cent. of the total.

TABLE I.—*United States Production*, 1913 *to* 1925.
(In thousands of barrels of 42 U.S. gallons.)

Year.	Production.	Year.	Production.
1913	248,446	1919	378,367
1914	265,763	1920	442,929
1915	281,104	1921	472,183
1916	300,767	1922	557,531
1917	335,316	1923	732,407
1918	355,928	1924	713,940
1925	728,410 (estimated)		

TABLE II.—*World's Production*, 1913 *to* 1924.
(In thousands of barrels of 42 U.S. gallons.)

Year.	Production.	Year.	Production.
1913	383,547	1919	555,796
1914	403,746	1920	695,281
1915	427,740	1921	765,928
1916	459,412	1922	858,715
1917	508,687	1923	1,017,100
1918	514,729	1924	1,012,927

Total World and U.S.A. Production of Crude Oil in period 1918-1925 compared with year 1913, in thousands of barrels of 42 U.S. gallons

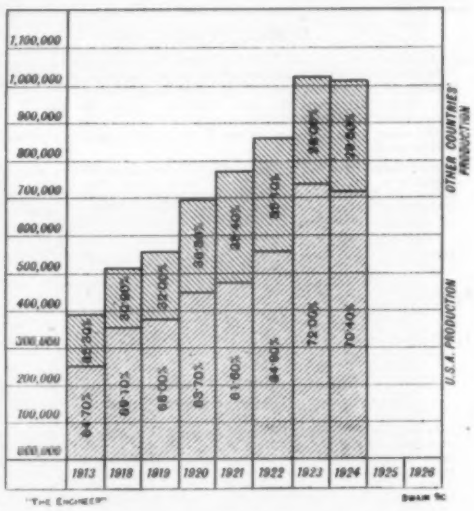

FIG. 1

In the last year—1924—for which the American returns are available, the production of motor spirit by the American refineries alone amounted to the enormous total of 1,279,950,000 gallons. In spite of this remarkable output, the demand for motor oils is continually overtaking the supply, owing to the enormous growth of the number of motors used for industrial and pleasure purposes.

The figures in Table III. give the registrations of motor vehicles in the United States and also in other countries, for the five years 1920 to 1924, compared with the year 1913.

TABLE III.—*Registrations of Motor Vehicles in America and Other Countries of the World.*

Year.	U.S.A.	Other countries.	Totals.
1913 ..	1,258,062 ..	— ..	—
1920 ..	9,231,941 ..	1,690,000 ..	10,921,941
1921 ..	10,463,295 ..	2,065,000 ..	12,528,295
1922 ..	12,238,375 ..	2,270,000 ..	14,208,375
1923 ..	15,092,177 ..	2,932,000 ..	18,024,177
1924 ..	17,591,981 ..	3,672,771 ..	21,264,752

Table IV. is based on the official figures for the imports of petroleum into the British Isles in the years 1922–23–24, and, taken together with Table III., it shows how remarkably rapid has been the development of motor transport in the United Kingdom, and how pressing is the necessity for new sources of supply of petrol and liquid fuels to be opened up without delay.

TABLE IV.—*Imports of Motor Spirit, Fuel Oil and Crude Oil into the United Kingdom in the Years 1922, 1923, 1924, in Gallons.*

Year	Motor spirit.	Fuel oil.	Crude oil.	Totals.
1922	311,190,000	392,618,000	217,133,000	920,941,000
1923	327,233,000	363,738,000	334,617,000	1,025,588,000
1924	422,310,000	385,581,000	465,184,000	1,273,075,000
	+ 111,120,000	— 7,037,000	+ 248,051,000	+ 352,134,000

The figures in the above table show that the imports of motor spirit into the United Kingdom had increased by 111,120,000 gallons, and of crude oil by 248,051,000 gallons in the two years ending December 31st, 1924. It is probable also that 33 per cent. of the "crude oil" has been converted into motor spirit in the oil refineries at the ports of entry, by application of the most modern system of cracking. Our total supplies of petrol in the year 1924—from natural sources—probably amounted therefore to close upon 600,000,000 gallons. The home production of benzol by the high-temperature processes of carbonisation carried on in the gasworks and by-product coke ovens of the country—in 1924—it is estimated would amount to 60,000,000 gallons. Even if the whole of the coal carbonised at these works were treated for recovery of the liquid fuels, the aggregate output of benzol would not exceed 80,000,000 gallons per annum, or one-seventh of our present-day requirements. Turning again to the figures given in Table III., it must be noted that Europe has a population nearly four times that of North America, and it is clear therefore that when the use of motor vehicles has become general amongst the populations of the European Continent, and the motor car is used to the same extent as in U.S.A., the demand for motor spirit will increase by leaps and bounds.

The liquid fuel position is therefore of paramount importance at the present time, and the statistics given above demand the most careful attention of all interested, either as producers or consumers, in the future of liquid fuels. The present writer considers they prove conclusively that unless new sources of oil can be tapped within the next five or ten years, there will be a world shortage of petrol and other liquid fuels in 1930; and in support of this opinion the following forecast of a U.S.A. Government Commission report may be quoted:—

"A complete survey of American oil resources by the Oil Conservation Committee appointed by President Coolidge reveals that at the present rate of consumption the country's oil supply will be exhausted within the next seven years. The Commission estimated that the United States contains only 5500 million barrels of oil capable of being refined by present methods; and that the present annual consumption is 800 million barrels. So alarming is the situation revealed by the survey, the Commissioners have advised the President to recommend that the use of oil should be abandoned for industrial purposes, and that coal, water power, or electricity should be employed wherever possible. Americans will also be urged to cut down oil consumption by more than one-half, and the Commissioners recommend that efforts should be made to induce the manufacturers to reduce the size of motors, so that motorists will be compelled to consume less petrol. The Commissioners have placed little reliance on a report issued recently by the American Petroleum Institute, in which it is stated that the oil reserves of the country amounted to 26 billion barrels. The Commissioners believe that the larger part of this reserve cannot be made available by any known methods; and they emphasise the fact that the promised discovery of new oil wells and fields is mere prophecy. They urged, finally, that as the national security was dependent upon the supply of oil for the navy, a policy of conservation of liquid fuel supplies ought to be immediately adopted."

A gradual rise in the price of petrol and of other liquid fuels is certain to be one feature of the gradual exhaustion of the American supplies of natural oil, and the economic position created during the next ten years will be very favourable therefore for placing on the market oil produced either by the low-temperature carbonisation processes or by some of the new synthetic processes of manufacture.

In a series of articles, of which this is the first, the writer proposes to describe the various processes that have been employed, either in the laboratory or upon a commercial scale, for the production of liquid fuels, and the latest information relating to their industrial exploitation and progress will be given.

The processes dealt with will be:—

(1) The low-temperature processes of coal carbonisation.
(2) The Badische Aniline und Soda Fabrik.
(3) The Bergius.
(4) The Fischer.
(5) The Patart.
(6) The Maihle.

THE PRODUCTION OF OILS FROM COAL BY THE LOW-TEMPERATURE CARBONISATION PROCESSES.

SINCE liquid fuels in the form of benzol and tar are obtained in considerable quantities at present from coal by high-temperature carbonisation, it was natural that chemists and engineers should have turned to coal as one of the most promising raw materials for increasing our supplies of liquid fuel, now that the oilfields of the world have begun to show signs of exhaustion.

Two methods have been proposed for obtaining an increased yield of liquid products from coal. The first, known as the low-temperature carbonisation process, is based upon the use of much lower temperatures than those employed in gasworks retorts and coke ovens; and the second, known as the Bergius process, is based upon concurrent carbonisation and hydrogenation under pressure.

English and American chemists and engineers have spent their time and energies chiefly upon the former process, while the latter has been developed in Germany. Each of these processes has now attained the industrial stage of its development; and in this and the following article will be presented the most reliable facts and figures that are obtainable, relating to the yield of oil and other by-products.

It has been calculated by the writer that if the whole of the 120 million tons of coal consumed at present per annum by the collieries, industrial works and factories of the United Kingdom for power generation and by the ordinary householder for domestic heating purposes were first submitted to low-temperature carbonisation, 312 million gallons of light motor spirit and 1320 million gallons of heavy oils, suitable for heating purposes or Diesel engines, would be obtained. These estimates are based upon a yield of 2·6 gallons of motor spirit and 11 gallons of fuel oil per ton of coal carbonised, after the distillation and refining of the crude products, and they prove that if the economic conditions were sufficiently favourable for their development, the low-temperature carbonisation process could provide one-half of our present requirements of motor fuel in this country.

It must be pointed out here that although coal contains only four elements—namely, carbon, hydrogen, oxygen and nitrogen—it is a very complex solid substance, and that when it is heated chemical changes occur which lead to the production of many other complex liquid and gaseous compounds. Professor V. Lewes, in his well-known book on "Liquid and Gaseous Fuels" (second edition, 1921), gives, in fact, a list of 190 different compounds which can be found in or extracted from coal after heating. What these compounds are depends not only upon the composition of the original coal, but also upon the temperatures attained during its carbonisation, and the difficulties which have to be overcome in the conduct of low-temperature carbonisation of coal are greater than those met with either in gas manufacture or in metallurgical coke production. The low-temperature tar also is much more closely allied to the coal from which it has originated than the high-temperature tar, and, as pointed out by Fieldner, contains chiefly paraffins, naphthalenes, cresols, xylenols and some of the higher phenols. The high-temperature process, on the other hand, cracks the primary tar partly into fixed gases and produces more viscous tars, containing phenols, cresols, anthracene, naphthalene and other aromatic bodies.

The methods of dealing with the tars obtained from high-temperature carbonisation have been elaborated during a half-century of experience and practice, and a market has been created for all the various bodies—liquid and solid—produced by the distillation of the original tar and tar oils. The chemical and physical composition of the low-temperature tars, and the best methods of their treatment are now the subjects of widely extended investigation, and the economic success of the low-temperature processes will depend largely upon finding markets for the by-products which are obtained, other than the light oils which can be employed as motor spirit.

Summarised details are given below of the general principles and yields of the leading processes of low-temperature carbonisation, which are now being worked upon an industrial scale in this and in other countries; but although much capital has been expended on their development, it is not yet possible to claim that under the present market conditions any have attained economic success.

The various processes may be classified in two main divisions, according as to whether the heating of the retorts is carried out internally or externally. The original Parker retort was heated externally and a modified form of it is still in use by the Low Temperature Carbonisation Company, which owns the original patents, and is working the process at Barugh, near Barnsley, in Yorkshire. The chief advantages of external heating are that the gas produced by the carbonisation is of high calorific value and can be employed for raising the calorific value of poorer gases, and that the hydrocarbons of value as liquid fuels which are contained in the gas can be recovered by "scrubbing."

Large and complicated nests of retorts are required, however, to give a large output of the carbonised products when external heating is adopted, for coal is a poor conductor of heat, and there is considerable difficulty in obtaining uniform heating of the charge of raw fuel, unless it is exposed to the heating medium in very thin layers. Internally heated retorts therefore are now coming into favour, although they cause the loss of the liquid hydro-carbons contained in the gas, and also lead to the production of a gas of very low calorific value. Table V. gives the different results for the two methods of heating and compares them with the yields obtained in ordinary gasworks and coke oven practice:—

TABLE V.—*Comparative Yields of High and Low-temperature Carbonisation per Ton of Coal (2240 lb.).*

	High-temperature carbonisation.		Low-temperature carbonisation.	
	In gas-works.	In coke ovens.	External heating.	Internal heating.
Coke, cwt.	12·5	13·0	15·0	13·5
Gas, cubic feet	15,600	11,500	4,000	35,000
Tar, gallons	10·67	11·00	25·0	10·0
Light oils, gallons (by scrubbing)	?	2·75	2·75	Nil
Ammon. sulph., lb. ..	15·25	27·5	11·0	15·0

NOTE.—The figures in col. 1 are based upon the official returns for all the gas undertakings in Great Britain in the year 1925, while those in cols. 2, 3, 4 represent the mean of Fieldner's figures, as given in the July issue of *Fuel*.

It will be noticed from the figures in the above table that the quantity of tar obtained is practically doubled by carbonisation at the lower temperature, but that the light oils obtained by scrubbing the gases are not increased, and that none at all are obtained from the gases produced by the internally heated retorts. This is due to the fact that these gases are too diluted with air and products of combustion, and are therefore too great in volume to render "scrubbing" practicable. The ammonia recovered in the form of sulphate from the low-temperature process, is also lower than from the coke oven process, so that there are some losses to be set against the possible gains.

It is therefore (1) the increase in the amount of tar and of the light oils obtainable from this tar by distillation, and (2) the production of a fuel which can be burned without smoke production in the ordinary domestic grate or for steam raising or for general industrial heating purposes, which renders the low-temperature carbonisation processes so attractive to chemists and engineers in this country and in America at the present time.

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THE derailment of October 12th outside Charing Cross Station of a passenger train bound for Ramsgate, which was mentioned in our Seven-Day Journal page for the 15th idem, was of interest to railway engineering and operating officers in view of the fact that Charing Cross Yard had only recently been re-signalled, and is operated by all-electric signalling. The facts were inquired into, on behalf of the Ministry of Transport, by Major Hall, whose report thereon has recently been issued. The engine, after the derailment, was on the down through line—as was intended—but the coaches took the direction of the crossing from the down through to the down local line. The relative signal is 410 yards in the rear of the facing points in question, and after the signal was replaced, the points should have been held by a track circuit. They were, however, moved between the engine and the leading coach, and on the matter being investigated it appears that, quite a short time before the accident, a contact piece in the track circuit control had been taken out and irregularly reversed. When, and by whom, that was done was not cleared up. Major Hall says that that feature is unsatisfactory, as, in consequence, the reason must be a matter of conjecture. The inspecting officer also remarks that the signalman must take some measure of responsibility for the accident, in that he altered the route without ascertaining from the illuminated diagram that the train had passed. It was most unfortunate that the man's mistake, the result no doubt of a wish on his part to expedite the working, coincided with the failure of the locking which should have prevented it.

The Manufacture of High-pressure Boiler Drums.

THE marked tendency during recent years towards the employment of very high pressures in steam boilers and chemical apparatus has called for the introduction of special manufacturing methods to produce the drums and other components of the plant which has to withstand these pressures. Ordinary boiler-making practice reaches its limits at pressures of about 600 lb. per square inch, not only on account of the difficulty of riveting the thick plates involved, but also because of the added difficulty of ensuring the maintenance of steam-tightness at the innumerable possible points of leakage. It is true that riveted boiler drums are in successful use at Langerbrugge, where the working pressure is 800 lb. per square inch; but in general it may be said that where pressures of over 600 lb. per square inch are concerned other methods of manufacture are preferred. The most obvious way of avoiding joints in a high-pressure drum is to construct the drum from a single hollow forging. It was in this way that the drums of the 1500 lb. Sulzer boilers, described in our issue of December 31st last, were constructed. The same method of manufacture was employed for the 1200 lb. boiler recently put into operation at Boston, in the United States, and solid-forged drums about 35ft. long by 4ft. diameter were adopted for the very large Clayton type boiler working at 620 lb. pressure, built for Amsterdam. Messrs. Krupp, of Essen, who have made a speciality of such forgings, have supplied more than 300 solid-forged drums for working pressures ranging up to 2000 lb. per square inch, a fact which indicates the extent to which high-pressure steam generation and chemical processes are being developed on the Continent. The manufacture of such forgings, however, demands large and powerful machinery and is correspondingly costly. As an

FIG. 1—STRAIN LINES IN S.M. PLATE

alternative to forging, the firm of Messrs. Thyssen and Co., of Mülheim-am-Ruhr, has developed a process of making seamless drums by welding, which, it is claimed, produces an equivalent article at something like two-thirds the expense. At first sight many engineers might be inclined to distrust a welded drum made of metal perhaps 3·5in. thick, with a weld running the full length of the body. It is certain, however, that with the precautions taken by Messrs. Thyssen in manufacture and in the subsequent processes of annealing and testing, the result is as good as could possibly be desired. Ample experience has now been gained to justify the method and to demonstrate the perfect reliability of the welded drums. We shall refer later to the tests carried out before the drums leave the works, which are exhaustive enough to remove any doubt as to the quality of the work and to dispel any lingering conservatism regarding the employment of welding, when carried out under proper conditions.

Messrs. Thyssen and Co. have been manufacturers of details for boilers for fifty years or so, supplying tubes, plates, drums, pressings, &c., to the boiler-making trade generally, but never competing themselves as boilermakers. Their close connection with the latter led them continually to increase and improve the equipment of their works so as to be in a position to meet any demands that the trade might make, whether with regard to size of plates or complexity of form of pressings. The manufacture of the stepped drums for the Garbe type of boiler, so largely used on the Continent, has for a long time been one of their specialities and they claim to be the first to supply pressed ends for Lancashire boilers, the advantages of which have been appreciated by boilermakers in this country. Their experience of welding dates back to the 'seventies of the last century, when the manufacture of butt-welded gas pipes and lap-welded boiler tubes was begun, the latter forming their definite introduction to the manufacture of boiler parts. In the year 1894 the firm put down a welding shop for the making of furnace tubes, domes, fireboxes, &c., and the next year the method of manufacture was improved by the installation of a water-gas plant, which not only increased the output, but permitted of far better regulation of the welding process. The production of corrugated furnaces of the Fox and Morison patterns made a further demand on the welding department and added to the experience possessed by the firm. Subsequent to this the construction of welded pressure pipes for hydro-electric installations paved the way more directly for the modern developments of the art of welding, particularly in respect of drums and containers of thick metal to withstand extremely high pressures. Among the more important welded pipe lines constructed by Messrs. Thyssen may be mentioned those of the

FIG. 2—STRAIN LINES IN S.M. PLATE

Ritom and Barberini installations of the Swiss Federal Railways, the former for a working pressure of 1180 lb. per square inch, with pipes varying from 650 mm. to 1100 mm. in diameter and from 8 mm. to 35 mm. in thickness, and the latter for a pressure of 1080 lb. per square inch with pipes 47 mm. thick. An example of still higher pressure is that for the development of the Lac de Fulby, with a pressure of 2340 lb. per square inch. Another kind of work, but equally conclusive as to the reliability of welded seams under pressures considerably greater than those usually met with in steam boilers, is exemplified by the hydrogen containers which were made in great quantities by the firm during the war for the German

FIG. 3—PYROMETER ROOM FOR ANNEALING FURNACES

forces. These containers were about 15 m. long with a diameter of 900 mm., and had a wall thickness varying from 38 mm. to 41 mm. They had to withstand a working pressure of 1420 lb. per square inch. About eight hundred such containers were manufactured by Messrs. Thyssen alone. In a certain instance one of these containers accidentally underwent a destructive test which amply demonstrated the soundness of the welded seam. Whilst it was being filled a drain cock blew off and the hydrogen escaping under a pressure of 750 lb. per square inch became ignited at the orifice. There was nothing to be done but to disconnect the container from the filling apparatus and leave it to its fate. The burning hydrogen heated the container locally and increased the internal pressure, with the result that an immense bulge appeared at the heated part, the metal being stretched from its initial thickness of 41 mm. to 5 mm. before rupture took place. The whole of the surface of the container was found afterwards to show evidence of strain, but in spite of this, neither the circumferential nor the longitudinal welded seams had given way at any point.

The first steam boiler drum to be constructed by welding was that of a Garbe boiler, which has been working since 1913 in a chemical factory at Niederingelheim-on-Rhine. In this case the rings of the drum were made by joining a semi-cylindrical plate already pressed for the tube seatings with another plain plate to complete the circle. The construction involved two horizontal seams, which were lap welded by means of water gas. There was really no great difficulty in carrying out the work, for fifteen years ago a properly equipped shop was able to make satisfactory lap welds by means of water gas in plates up to 30 mm. thick. For a long time this thickness represented the extreme limit for the kind of welding in question, plates of greater thickness having to be joined by welding a separate wedge-shaped piece of metal into the joint. That lap welding was satisfactory for boiler work had been abundantly proved by the number of corrugated furnaces for marine boilers in service, but it required confidence both on the part of users and manufacturers to adopt it for drums, particularly as for the pressures then in vogue riveting presented no difficulty. When drums for greater pressures, and consequently of thicker metal, were called for, it became evident that some alternative to a riveted construction must be found, and the choice lay between forging from the solid and developing the welding process to meet the situation. Messrs. Thyssen chose the latter, as we have already said, realising that it had such advantages from the point of view of cost that it would facilitate the adoption of higher pressures in industry, and also that the use of rolled plates instead of heavy forgings as constructional material tended of itself to increase confidence. The technical difficulties they knew they could overcome, and they also knew that time and effective proof of quality of every drum turned out would eventually remove the obstructive conservatism which resists the introduction of new methods, though less on the Continent than at home.

In the year 1921 Messrs. Thyssen effected a thorough reorganisation of their welding shop, putting down machinery to deal with work of any magnitude that might reasonably be called for, and facilitating the employment of every detail of manufacture which experience and special experiments had indicated as desirable. Their rolling department was likewise improved and now contains a reversing mill with a table 4·5 m. long, illustrated in Fig. 4, page 247. This machine will deal with ingots weighing 30 tons, from which plates of a finished weight of 16 to 18 tons can be made. The maximum finished width of plates from this mill is 4220 mm., with a length of 16 m. From such plates a boiler drum with an internal diameter of 1250 mm. can be constructed with a single longitudinal welded seam. It is only above this diameter that it is necessary to form the circumference of a drum from more than one plate. After leaving the rolls the plate passes to a cooling table, where it rests alone—the plates being never superposed on this table—thus being allowed to cool uniformly. When cold the plate is trimmed, from 60 to 100 per

FIG. 4—REVERSING ROLLING MILL

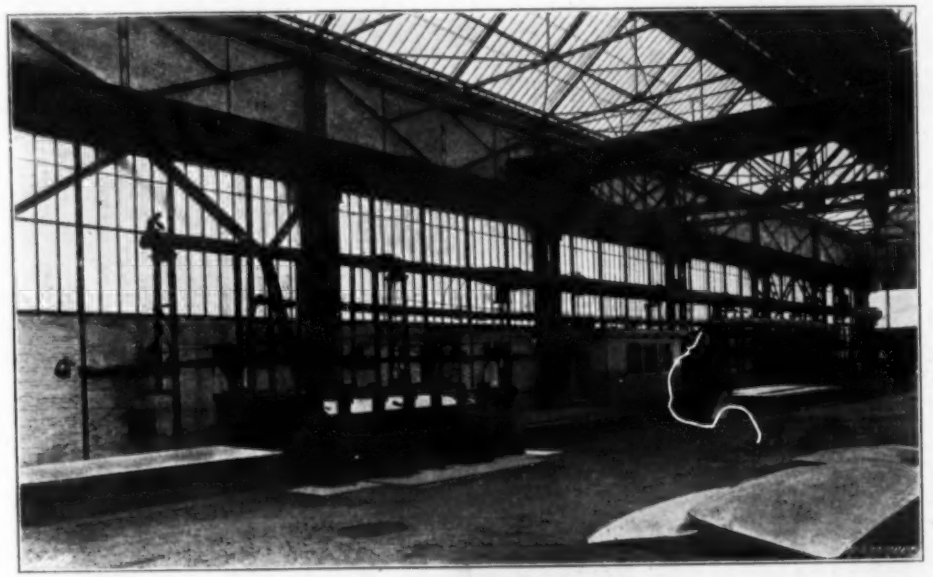


FIG. 5—PLATE ANNEALING SHOP

FIG. 6—BENDING ROLLS AND DRUM ANNEALING FURNACE

FIG. 7—BAY OF WELDING SHOP

cent. of the weight of the finished plate being removed in this process, so as to ensure the absolute soundness of the remaining metal. The effect of the shearing, however, is to alter the structure of the metal for some distance inwards from the cut surface. A section, etched by Fry's reagent, shows a network of strain lines extending a long way back from the surface. These lines are composed of metal of which the structure has been modified by the stress to which it has been subjected. The photographs reproduced in Figs. 1 and 2 show the appearance of these strain lines on the upper and lower sides of a plate of mild Siemens-Martin steel 47·5 mm. thick after shearing. The lines can be traced back into the plate for a distance of 135 mm. The effect of these strain lines on the behaviour of the material has not yet been completely investigated. Tensile and bending tests on steel permeated with strain lines have not, however, given any cause for anxiety, but the results of impact tests have not been so satisfactory. It is, in any case, certainly advisable to remove all effects of strain in the material, whether from shearing or any other cause, and to this end the sheared plates are thoroughly annealed.

The annealing furnaces are situated in a separate shop—Fig. 5—and the work, by reason of its importance, is carried out by a special staff of men. The largest of the annealing furnaces will accommodate plates 16 m. long by 4500 mm. wide. All the furnaces are gas fired and the means for regulating the supply of fuel enable the temperature to be kept constant and at the desired degree in all parts of the interior. The temperature is continuously recorded by a set of pyrometers installed in a separate room, as shown in Fig. 3. The plates are maintained at a temperature from 900 deg. to 920 deg. Cent. for the required time, and afterwards slowly cooled, the effect of this treatment being to remove all traces of strain and to restore the material to a normal condition.

After annealing the plates are inspected, and they then pass to the welding shop. The first operation they undergo is to have their edges planed to a bevel-edge for making the subsequent lap joint—Fig. 9. After this has been done they are again heated and passed through the bending rolls. The effective length of the rolls, of course, determines the maximum length of the finished drum. The most powerful set of bending rolls—which can be seen in Fig. 6—is capable of taking a plate 90 mm. thick and bending it into a cylinder 9·5 m. long. Up to this length, therefore, and up to 1250 mm. internal diameter, boiler drums can be made of a single sheet, with one weld only. If larger drums are required two or more plates welded together would be used. The rolled plate, with its longitudinal edges overlapping, ready for welding, is transferred after cooling to the welding machine. There are a number of these machines of various sizes, but the principle employed is the same in all. The drum to be welded is placed on a carriage with its seam uppermost. The carriage runs on rails in a trench, so that the work is at an appropriate height for the operators, of which there are usually only two to a machine. The carriage can be traversed longituninally by electric power. It picks up its current from a concealed "third-rail." The cradle on which the drum rests can also be given an oscillating motion, both motions being under the complete control of one of the operators, who is thus enabled to bring any desired portion of the seam or the metal on either side under the action of the flame or the hammer. When the drum is in position, there is in its interior the end of a long stiff cantilever arm, the other end of which is attached to the machine framing. This arm carries a burner, and just beyond it an anvil. The fixed bridge of the machine also carries a burner opposite the one inside the drum, and opposite the anvil is a pneumatically-operated hammer. The two burners which can be adjusted to make contact with the drum consist essentially of blocks of refractory material about 18in. long, from a slot along the centre of which emerges the flame of burning water gas. The burners are closed down on the spot to be heated, and when the metal has been raised to a welding temperature, they are lifted and the drum moved so as to bring the heated part under the action of the hammer. The latter strikes good heavy but perfectly regulable blows which consolidate the metal, after which a further portion of the seam is brought under the action of the burners, and the process repeated. One bay of the welding shop, with four welding machines of various sizes, is shown in Fig. 7.

The weld having been finished, the drum is taken to the annealing furnace—shown in Fig. 6—in which it is raised to a temperature of about 900 deg. Cent. to remove all strains which may have been caused by welding. It is removed from the furnace by a porter bar carried by a travelling crane, and placed while still hot, once more in the bending rolls, alongside where it is given its final perfect cylindrical form.

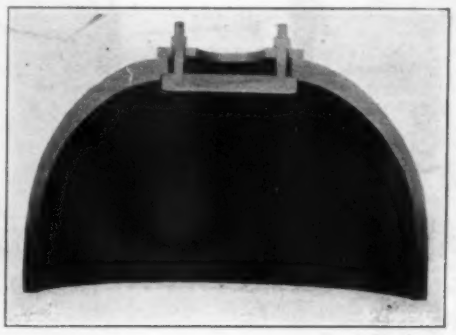


FIG. 8—SECTIONED DRUM END

When it has been made perfectly true it is allowed to run round idly on the machine without being subjected to any pressure from the top roll until it has cooled sufficiently to obviate any danger from warping under its own weight. When completely cold the ends of the drum are faced up true in a special lathe, in order that a preliminary hydraulic test may be applied in a pipe-testing machine. The test pressure employed is about one and a-half times the working pressure, and should the drum stand this satisfactorily,

FIG. 9—SCARF-LAP WELD

it is assumed that the weld is sound, and that the expense of further manufacturing operations may be safely incurred.

The next process is to close the ends. To do this the end of the cylinder is heated and the metal then worked together by means of curved dies in a vertical hydraulic forging press. The process is one of forging rather than of "bottling." The work of the press results in the ends assuming a hemispherical shape, with a comparatively small central opening, which eventually becomes a manhole or inspection hole. The closing in of the ends thickens the metal considerably, particularly towards the centre, thus strengthening the drum round the manhole very simply and effectively. This thickening is clearly shown in the photograph of a sectioned drum end—Fig. 8. After the edges of the manhole and the seating for the cover have been machined, the drum may be regarded as finished. It has, however, still to undergo its final testing and treatment before being allowed to leave the works. Boiler regulations, on the Continent, generally stipulate for a test pressure of 5 kilos. per square centimetre, or, say, 70 lb. per square inch only, above the working pressure. For boilers designed for working pressures of 800 lb. to 1500 lb. per square inch, such a regulation is, of course, ridiculously inadequate. Messrs. Thyssen therefore have developed a system of testing in which their drums are subjected to a hydraulic pressure which stresses the metal right up to its limit of elasticity. Probably no such drastic test on so large and important a component as a boiler drum has ever been carried out before; at any rate, as a regular process in manufacture. For the test the drum is whitewashed all over, the manhole covers are put on, and the drum is mounted on anti-friction rollers conveniently for observation. At intervals of a few feet along its length, thin steel measuring tapes are wound round it—as shown in Fig. 10. Each tape makes rather more than a complete turn. One end is fixed to a support independent of the drum, and the other is weighted, so that the tape, though under the tension of the weight, is perfectly free to accommodate itself to the expansion of the drum. The amount of the circumferential expansion for any given internal pressure can be easily read at the point where the tape passes itself on the drum. In addition to the tapes, a large number of indicating pointers, mounted in holders in which they can slide with a little friction, are arranged systematically normally to the boiler drum, so as to indicate the expansion of parts specially selected for observation. A perfect record of the strains caused by the internal pressure is thus obtained, and the stresses, predicated by calculation, can be checked. It would seem humanly impossible that either defective material or workmanship could withstand so thorough and searching a test. The hydraulic pressure available permits of drums being tested up to an internal pressure of 350 atmospheres, or, in round numbers, 5000 lb. per square inch.

By stressing the drums up to the elastic limit certain structural changes are produced in the material, which it is desirable to eliminate. With this object in view, the drums are once more placed in the annealing furnace and the metal restored to its original soft and ductile condition. The final result is a drum, of which the soundness has been demonstrated by the severest test that could be carried out, short of destruction, ready for delivery to the boilermaker free from any strain or local hardness. It should also be noted that by stressing the drum to the elastic limit by internal pressure, its absolute circularity is insured, so that no subsequently applied pressure can set up secondary stresses owing to deformation. Nor does the efficacy of the treatment depend for its justification upon theoretical considerations alone. To assure themselves that annealing really did restore the strained metal, as well as to satisfy themselves that a properly made weld was in every way as sound as the solid plate, Messrs. Thyssen have carried out a most elaborate series of experiments upon a full sized drum 1130 mm. diameter, made of plates 47·5 mm. in thickness. After annealing the drum was cut up, and scores of the test pieces were taken, longitudinally, circumferentially and radially, and from various depths in the plate. As might be expected, special care was taken to have a large number of the test pieces cut from metal containing the weld. It would take up far too much space to describe in detail the results obtained, for which we may refer the reader to a paper read in September, 1924, by Mr. C. Wallmann, a director of Messrs. Thyssen's, at the Kiel meeting of the Vereinigung der Grosskesselbesitzer E.V. It is sufficient to say that so far as tensile tests were concerned, there was no appreciable difference between test pieces taken from the weld and those taken from the solid metal. Impact tests on pieces taken from the welded zone showed indeed a somewhat higher resistance than others to fracture. This is possibly explicable on account of the intensive working which the metal had had in the neighbourhood of the weld; but in any case the difference was so slight that for all practical purposes the tests showed that the drum consisted of perfectly homogeneous metal.

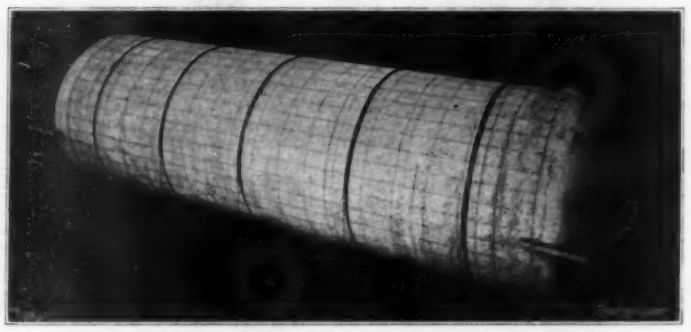


FIG. 10—DRUM READY FOR FINAL TEST

FIG. 11—DRUM 3·5in. THICK SECTIONED

Fig. 11 shows a lap-welded drum with a wall thickness of 3·5in. The increased thickness of the ends is clearly shown in the photograph. The drum was cut up to enable the weld to be thoroughly examined, and to enable test pieces to be cut from various parts.

In conclusion, we have to thank Messrs. Thyssen for enabling us to make a full inspection of their processes of manufacture and testing employed in the production of their drums for very high pressures, and our thanks are specially due to Mr. Roeckner for his courtesy on the occasion of our visit.

AT the Pullman Car Company's annual meeting on February 14th it was stated that on May 15th a new train would be put into service between Calais and Brussels which would run in connection with the 11 a.m. from Victoria. The train would be due in Brussels at the same time as the Paris train was timed to arrive in the latter city.

A Coal Pulverising Machine.

WE recently had an opportunity of witnessing some trial runs on a new coal pulverising machine which is being put upon the market by Mayhew, Ramsay and Co., Ltd., of 11, Victoria-street, S.W. 1, and is illustrated by the line drawing below.

The general principle of the machine is more or less familiar, comprising, as it does, a series of beater arms hinged to discs on a rapidly rotating shaft, but in some respects the machine is rather peculiar.

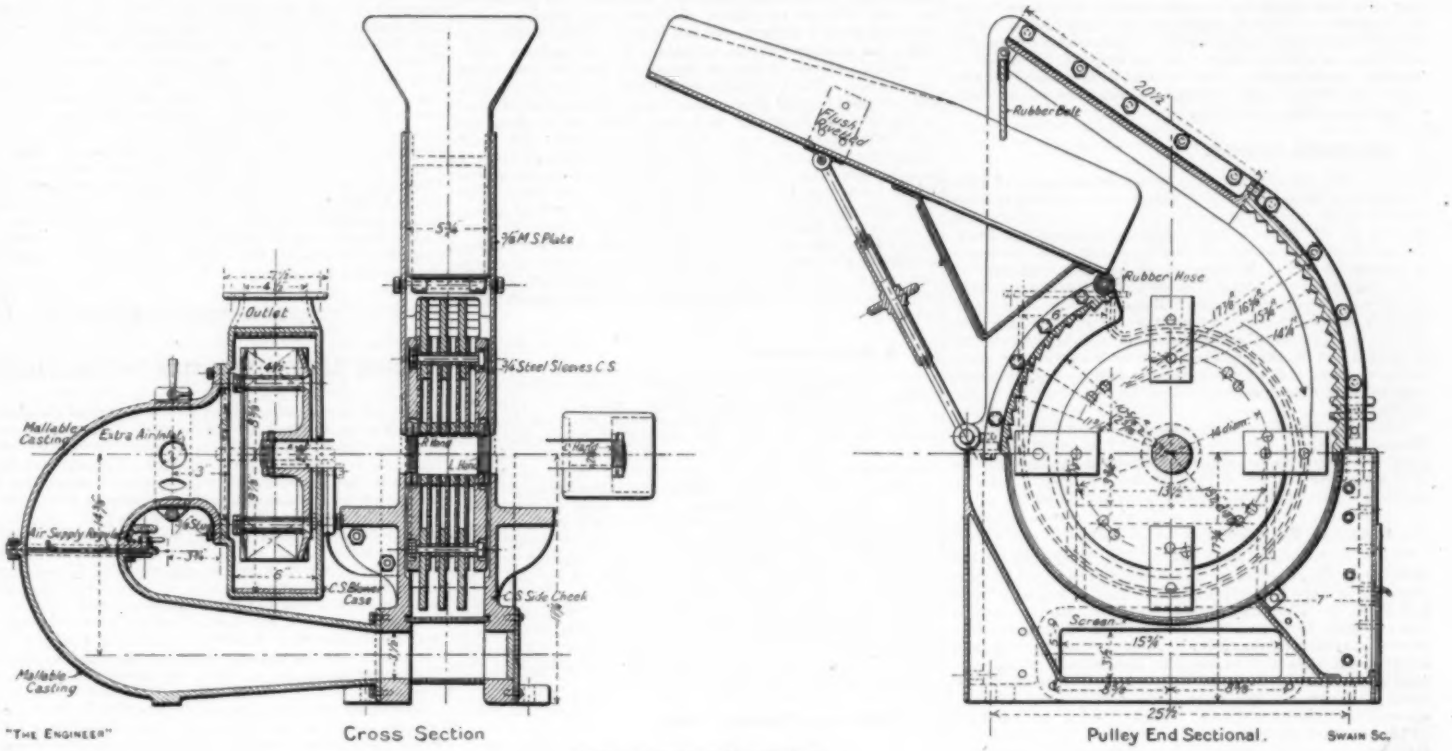
The interior of the casing in which the beaters rotate is in parts, formed of serrated cast steel segments, and the coal, fed in at the top, is thrown violently against these serrations by the action of the beaters and is thoroughly pulverised. It should be pointed out that at no part of the circumference is there less than ¼in. clearance between the beaters and the casing, and there is nowhere any rubbing contact. At the bottom of the casing there is a screen of perforated sheet metal, and below this there is a trunk connecting with the inlet eye of a centrifugal fan, the impeller of which is mounted on the same shaft as the beater discs. The pulverised coal is consequently sucked through the screen and is discharged by the fan into a cyclone, not shown in the drawing, which separates the air from the coal.

The remarkable thing about the machine is the fact that although the holes in the screen are as big as ¼in. in diameter, the coal delivered by the fan, on the occasion of our visit, was so fine that at least 90 per cent. would pass a 100-mesh screen, while the remainder was very little coarser and there were no pieces approaching ¼in. in diameter. It would seem that the peripheral inertia of the larger particles is such that they pass right across the openings in the screen before the draught caused by the fan has time to deflect them, and that the comparatively large surface area offered to the air current by the fine stuff enables the draught to carry it away through the screen. By adjusting the suction pull of the fan and choosing the proper size of opening in the screen, practically any degree of fineness can be obtained without there being any liability for the screen to become choked. The strong draught of air passing through the machine also has the merit that it keeps everything quite cool and the pulverised coal is delivered practically at room temperature.

The constructional details of the machine need little comment, as they are fairly obvious in the drawing; but the fan requires a little explanation. It has been found that if such a thing as a bolt is accidentally dropped into the pulveriser, it will be shot straight through the screen and sucked up into the fan, where it would seriously damage the impeller vanes. For this reason the vanes are loosely pivoted to the discs and are kept in the proper working position by centrifugal force when the machine is running. If, however, a heavy mass finds its way into the fan, the vanes give way and suffer no serious damage. On the back of the impeller disc there are some little vanes, which produce a draught inwards at the shaft entrance and prevent any dust escaping there. Near the inlet to the fan, it will be seen, there is a series of extra air inlets, which can be opened to admit a large volume of air if the powdered fuel has to be delivered to a distance, while further back there is a damper to control the suction under the pulveriser screen.

In the drawing only four sets of beaters are shown, but, as a matter of fact, there really are eight sets. They are made of alloy steel, hardened, and work on case-hardened pins. The rotor, by the way, runs at from 3500 to 3750 revolutions per minute. The top half of the casing is pivoted near the horizontal centre line, so that it can be swung back to expose the rotor. It is usual to fit a magnetic separator in the delivery to the inlet shoot of the pulveriser and to provide a feeding device which can be adjusted to give any desired rate of feed.

Reverting to the performance of the machine on the occasion of our visit, a rough slack, distinctly moist, was being disintegrated at the rate of about a ton an hour, and we were informed that it contained at least 12 per cent. of moisture. This material was put directly into the pulveriser, without any preliminary drying, and the resultant powder was certainly of a nice consistency for feeding into a furnace burner. There was not, in the course of such an impromptu trial, an opportunity for testing the true efficiency of the plant, but we noted that it required some 50 amperes at a pressure of 420 volts, or, say, a matter of 27 horse-power, to run the machine and the line shafting connected therewith. But what we were most struck with was its accommodating nature. For instance, a big handful of large wire nails could be thrown into the inlet and almost the whole lot was pulverised—a fact which was demonstrated by a comparison, magnetically, of the powder delivered by the fan with the residue left in the pulveriser after a short run. Again, a mixture of flints, matches and coal was run through the machine and emerged as an impalpable powder, without there being any sign of ignition or trouble. We understand that these machines are being made in several sizes and that designs have been prepared for their adaptation to marine work.



COAL PULVERISING MACHINE

SHIP LOADING AND UNLOADING FACILITIES.

A PAPER, which was read by Mr. R. I. Dodsworth before the North-East Coast Institution of Engineers and Shipbuilders on Friday, February 25th, forms a valuable contribution—mainly from the point of view of the steamship manager—to the many problems which are involved in the economic loading and unloading of merchandise on board ship and on land. The author distinguishes between the liner which usually carries quite an exceptional amount of cargo-working gear, and the tramp ship which has generally to rely on her own devices. He estimates that the cost of derricks and winches alone in a modern cargo vessel represents about 5 per cent. of the capital cost of the ship.

In dealing with "Despatch from the Standpoint of the Vessel," Mr. Dodsworth indicates some measures which, if taken, would speed up the working of cargo. They include a better subdivision of the ship in the matter of cargo holds, improved hatch coverings, hatches and coamings, gangway doors and racks, and more modern derricks and winch gear. As regards delays in port, such as may arise from congestion, the suggestion is put forward that two shifts of eight hours would effect a great improvement in alleviating port congestion at certain times of the year, although probably three eight-hour shifts would prove the ideal arrangement. The retardation of both shore and ship equipment by vexatious trade union regulations is also referred to. The equipment of ports and docks is then dealt with, and some comparisons are made between British, continental and American ports in regard to their equipment. Various methods of dealing with general cargo are described and some criticisms are made. Bulk cargoes are dealt with in turn, in sections dealing with coal, iron and other ores, grain, oil, cold storage, pit props and timber. In conclusion, the author mentions with appreciation the reports of the Port Facilities Committee appointed by the Chamber of Shipping in 1923 and 1924, and the recent report by the same authority's Traders' Co-ordinating Committee on Dock Charges. In the main, Mr. Dodsworth says, shipowners have been progressive in their policy, and with the anticipated improvement in trade it behoves port authorities to give of their best in order to cope with the position. He further suggests that those authorities who have not taken in hand schemes, particularly with Government assistance, for the vital needs of such ports, are seriously retarding the trade and injuring the reputation of this country from the point of view of port speed.

SIXTY YEARS AGO.

IN the early 'sixties of last century certain visionaries began to turn their attention to the use of petroleum as a fuel in boilers in substitution for coal. The oil at that time cost from £8 to £20 per ton, and even granting the extravagant claims made for the increased duty that the new fuel would give, the proposal was received by the general body of engineers with scoffing. As well, they said, might it be suggested that the Cunard Company should use rectified spirits of wine or the Royal Mail Company some of the diamonds which it carried as cargo. We, in this journal, added our opinion to that of those opposing the scheme and showed that on chemical analysis petroleum could not have "a power as a calorific agent" much in excess of one and a-half times that of the best steam coal as used in the Navy. The position of liquid fuel as a rival to coal soon, however, suffered a great change. In a few years time petroleum fell in price until it could be obtained in this country for £5 per ton in the crude state. In addition, other forms of liquid fuel, such as creosote or "dead oil of tar" were found to be suitable, and as these substances could be obtained for 15s. to 20s. a ton the outlook became entirely altered. In our issue of March 1st, 1867, we recognised this fact, and in the course of a leading article on the subject presented a promising picture of the possibilities of two processes for the combustion of liquid fuel in boilers which we had recently inspected. In one, that of Mr. Richardson, the fuel oil accompanied by steam was injected into holes running longitudinally in a block of porous clay lying inside the furnace. The oil permeating the porous material and rising through it was volatilised at its surface and was burnt as a gas. The steam was dissociated and the hydrogen obtained from it was regarded as an additional fuel. In the other system, that of Mr. Aydon, the oil, heated by means of a steam coil, was delivered from a cistern to a device on the scent distributor principle, which by means of highly superheated steam injected it into the furnace in the form of a spray. The furnace fire-bars were protected by a layer of cinders, which remained hot throughout the run. Trials showed that either of these systems would give a duty of about 19 lb. of water evaporated per pound of fuel used, or double the duty obtained from coal. We were impressed with the practical importance of the subject, but in connection with the use of liquid fuel on board ship we foresaw many serious objections. One curious disadvantage only was mentioned for the time being. The Aydon apparatus, we said, was so noisy when at work that in a naval engagement the thunders of the artillery would be drowned by the trumpeting of boilers generating tens of thousands of horse-power by means of liquid fuel.

A BOLIVIAN Presidential Decree constitutes a Commission to co-operate with a similar Commission appointed by the Peruvian Government to make a complete survey of the eastern side of Lake Titicaca, the highest sheet of water in the world, with a view to the construction of a railway from Juliaca to La Paz. Situated on the Southern Peruvian Railroad, Juliaca stands at an altitude of 12,550ft. The late Henry Meiggs, who built the Southern Railway of Peru from Juliaca to Santa Rosa, considered as far back as 1875 the construction of such a railway physically possible, and in spite of the costliness of material and its transport to such a lofty point, the Bolivian Government desires that the railway should be built, and is negotiating with American financiers who profess themselves undismayed by the difficult topography of the country and the existence of economic disadvantages.

South African Engineering Notes

An Aerial Survey.

The Air Survey party, under Major Cochran Patrick, which is to make an aerial reconnaissance of 22,000 square miles of the Rhodesian-Congo Border Concessions has arrived, and, with the two De Haviland planes which it is to use, has proceeded up country. The expedition has brought with it a special camera which possesses many distinctive features. It is known as the Eagle type, and was originally designed by an officer serving in the Royal Air Force, the first model being produced at the Farnborough establishment. In the form in which it is now being made available for commercial purposes, it undoubtedly represents a most efficient instrument. The African area to be photogaphed consists mainly of what is technically known as Orchard bush, held by the Rhodesia-Congo Concessions, for which Minerals Separation, Ltd., acts as general manager. It covers some 52,000 square miles. A portion of this huge tract will be flown over, in the first instance, in a series of parallel lines, in such a way as to enable the whole to be covered by oblique aerial photographs. These photographs will then be studied by the geologists, and, according to the information obtained, certain areas will be selected to be mapped by means of vertical photography. The vertical photographs will be taken with 60 per cent. overlap, so as to enable stereoscopic comparison to be carried out.

New Cement Factories.

The rapidly growing industrial strength of Port Elizabeth is to be added to by the erection of a big cement factory there almost immediately. That is the decision arrived at by White's South African Cement Company. The new concern has been finally agreed upon as the result of a visit by Mr. P. M. Stewart, of London, chairman of the Associated Portland Cement Manufacturers, Ltd., the British Portland Cement Manufacturers, Ltd., and White's South African Cement Company, Ltd. Its purpose is to work what are described as peculiarly valuable deposits near Hankey in the Gamtoos River Valley, some 60 miles from the city on the Avontuur narrow-gauge railway. A model factory is to be constructed at the earliest date.

Following the foregoing comes information from the Pretoria Portland Cement Company, Ltd., that the company has acquired an important limestone property, also in the neighbourhood of Port Elizabeth, with a view to erecting a cement factory at that port immediately.

Oil-boring Operations.

A telegram from the resident engineer of the Petroleum Corporation in South-West Africa, which was received in Cape Town towards the end of January, read as follows :—"Heavily oil-soaked and discoloured core was cut at 728ft. level and continues. Samples sent to-day. Strata softening perceptibly." A week later the engineer telegraphed that the favourable indications of oil were steadily increasing with the depth, and that at the 755ft. level the core was not only heavily oil-soaked but also showed bituminous deposits. These reports are regarded as the most conclusive evidence in support of the confident forecasts of Dr. Reinecke, the well-known oil geologist, yet received. The stratification disclosed in the boring operations, which have been conducted under skilled direction during the past year, is said to be the same as that of the Texas oil areas, and quite in accordance with Dr. Reinecke's forecast. The Corporation has a lease over approximately 275,000 acres, giving an exclusive right to prospect for oil within specified areas in the district of Keetmanshoop, Berseba and Gibeon for five years from April 24th, 1924. The territory acquired is divided into seven oil areas, and ten base mineral prospecting claims areas. Included in this area are stated to be several other "dome" structures. It was anticipated that oil would be found at a depth of about 3000ft., but with the favourable indications encountered so early there is reason to anticipate that oil pools may also be encountered earlier. At any rate, it is clear that a most interesting stage in the search for oil has been reached, and further developments will be watched with interest.

Ermelo Torbanites.

On at least half-a-dozen occasions companies have been formed in the Union to work the Transvaal oil shales and torbanites, particularly the torbanites of the Ermelo District, and to encourage them to proceed the Government has offered bounties. Always, however, something has gone wrong at the last minute, and so far no real start has been made. That there are enormous quantities of torbanites, giving a very high recovery of oils, has been demonstrated by a number of large scale experiments, and some of the companies holding large areas have been continually seeking to interest foreign capitalists. Although another fiasco may be in store, it does seem just now as if the long delayed start may be made, and that Ermelo may prove to be one of the important centres for the supply of high grade petrol. Dr. E. Neufeld, a well-known South African consulting chemical engineer, has just announced that a German group now holds ground at Ermelo containing about 15,000,000 tons of torbanite, from which petrol and other oils may be profitably extracted. He states that the prospectors have already dug to a depth of 270ft., and have come upon seams 28in. thick. Some months back a sample of 25 tons of torbanite was sent to Germany to be treated and experimented upon in the laboratories of a German firm. The first report was highly satisfactory, and the final report was expected about the middle of February. Conditional upon that report, a large retorting firm in Germany, backed up by German bankers, who are prepared, it is said, to go to the extent of £2,000,000, will set up a big plant at Ermelo, and start an oil industry. It is understood that owing to the disinclination of British interests to come forward, until there was satisfactory proof of success, the offer was made to Germany. To exploit the deposits skilled German chemists and engineers will be brought from Germany, but, of course, South African labour will be largely employed. That with adequate capital such an enterprise should be a good paying one seems certain, for large scale experiments have demonstrated yields running from 40 gallons to as much as 90 gallons of oil per ton of torbanite, while the estimated costs of extraction were so low that a profit of several pounds per ton was regarded as certain. Should success attend this effort to start the industry it will, of course, mean a great deal to the Union, but it will be a cause of much regret that, as in the case of platinum, British firms have allowed German metallurgists and chemists to solve the problems of the extraction of the metal in the one case, and of the oil in the other, for the solution of the problems gives to the solving firms the orders for the plant and machinery required. In the case of platinum the outlay will mean several hundreds of thousands of pounds in orders in a very short space of time, while as regards the torbanite industry, the amount that will have to be expended in plant should be considerable

Platinum Production.

The output of platinum from the Ouverwacht Mine in the Lydenburg District continues to improve. During the month of December the reduction plant milled 2250 tons. The crude platinum produced was estimated to yield 874 oz. of refined platinum and allied metals, equivalent to 7·8 dwts. per ton milled. The prospecting shaft has disclosed values averaging 3·7 dwts. from 386ft. to 400ft. Cross-cutting on the 400ft. level is now being carried out. The December output was a record, exceeding the previous best by 25 oz. Since the reduction plant started operations, in February last year, 6830 oz. of platinum had been recovered up to the end of January last, and, as far as can be calculated from the information at present made public, the profit on the 14,839 tons of ore milled must have run to somewhere about £7 per ton. The Potgietersrust Platinums, Ltd., has also commenced operations, and quantities of concentrates have been sent overseas to be refined. The company, however, is awaiting particulars before publishing any figures as to the recovery, &c. It is, however, understood to be perfectly satisfied with the results, as estimated, and is putting down a much larger plant.

A Steam Omnibus.

Members of the Tramway and Lighting Committee of the Johannesburg Town Council have just had a trial run on a new type of steam omnibus. The vehicle, which burned coke from the municipal gasworks, made a tour of the suburbs, and the speed was found to compare favourably with that of the ordinary type of motor omnibus. The vehicle is fitted with pneumatic tires and "rides" very smoothly. The chassis is similar to that in daily use for commercial vehicles on the Rand, but is fitted with a large passenger body. Among the other advantages claimed for it are fuel economy, smooth running, great power and good flexibility in traffic. The vehicle is constructed on a Sentinel chassis; it is larger and more roomy than most of its petrol rivals, is upholstered in leather, and fitted with the springback seats. It is claimed that the machine will operate over a 13 mile route for a running cost of 10s. per day, as against the average cost of £3 for a petrol engine.

Progress at Dunswart Works.

In order to cope with increased volume of its business, the Dunswart Iron and Steel Works, Ltd., near Johannesburg, has completed extensions to its plant, which will materially affect both quality and output from its establishment. The steel foundry floor space available has been doubled, which will enable the company to handle considerably more than double the tonnage of steel castings, as the effect of the increased space available will be to enable it better to arrange the sequence of manufacture and handling in general. A general speeding up will be a natural consequence of these alterations. The additions to the foundry include a large moulding machine, a special heat treatment plant—principally for manganese steel—and several annealing and drying ovens. The company's 18in. rolling mill has been removed to a site adjoining its 8in. and 12in. mills, whilst an 18in. forge roll has been added. The effect of the latter will be to improve considerably the quality of the wrought iron bars manufactured. It will also lessen costs and increase production.

A British Combine.

Vickers Ltd. and the Metropolitan Carriage Wagon and Finance Company, Ltd., have combined to form a South African company, bearing the title of "Vickers and Metropolitan Carriage (South Africa), Ltd." The step has been taken in order that the interests in this country of the parent companies shall be co-ordinated and centralised, and as each party to the arrangement has numerous associates and subsidiaries, the South African company will represent a wide and diverse range of industrial activities. Major D. Wauchope, who has for a considerable period represented in the Union the various Metropolitan Carriage interests, has been appointed chairman and managing director of the South African company. Associated with him will be Mr. M. G. Atkinson, from the headquarters staff—London—of Vickers Ltd.

Accident Rate in Mines.

That there has been a considerable and almost constant fall in the accident rate in the gold mines, as compared with the figures for 1913, was shown by the Gold Producers' Committee in a statement submitted to the Mining Industry Arbitration Board that sat at the end of January to hear arguments on the miners' behalf for the increasing of the rates of wages, and on the employers' side that while the wages paid to-day were higher than in any other part of the world, the work done by the men involved less worry and less time than before the provision of the new types of drilling machines and better facilities generally. The death-rate figures per thousand over the whole of the industry were given as follows:—1911, 5·71 per 1000; 1912, 5·14; 1913, 4·94; 1914, 4·21; 1915, 3·99; 1916, 3·91; 1917, 3·35; 1918, 3·18; 1920, 3·15; 1920, 3·11; 1921, 2·96; 1922 (industry disorganised for the first three months of the year owing to the strike), 2·72; 1923, 3·27; 1924, 3·35; 1925, 3·11. It has been computed that the present rate of fatality represents a saving of thirty-seven white men's lives per annum and of 128 natives per annum. In terms of work done, the comparison shows that in the year 1925 the work was carried out twice as safely as in 1913.

Johannesburg's New Gasworks.

For the first time for a long period British tenders for a substantial contract have been lower than those of foreign competitors. Johannesburg has for some years been finding its present gasworks plant insufficient for the growing demand. It therefore obtained the permission of the provincial administration to expend a sum of £300,000 approximately for the purpose of erecting a works that would not only be adequate for present requirements, but provide for the estimated annual increases for years to come. The total estimate is made up as follows:—£220,000 for plant, £65,000 for distribution, and £15,000 for extras and contingencies. Tenders were invited for the plant and buildings, but do not cover the item of mains for reticulation of the gas throughout the city and suburbs. Tenders for this piping work will be placed at a later date. The tenders for the plant were received towards the end of January, and although the details of each tender were not then made public, it was known that the British tenders were lower than the German offers. It was understood that the difference between even the highest British tender and the cheapest German tender was considerably in favour of the British quotation. Of the eight tenders submitted, only five were complete offers to build the plant and structure. The complete tenders ranged in price from £153,160 to £266,968. The firms which tendered were:—Bruce Peebles and Co., Ltd., Edinburgh; Drakes, Ltd., Halifax; Woodall-Duckham Vertical Retort and Oven Construction Company (1920), Ltd., London; West's Gas Improvement Company, Ltd., Manchester; Julius Pintsch, Ltd., Germany; Francke Werke A.G., Germany; Aug. Klonne, Germany; Skodaworks, Ltd., Prague.

FRENCH ELECTRIFICATION DEVELOPMENTS.

THE following extract from a recent issue of the *Journal de la Marine Marchande*, dealing with the consequences to the port of Bordeaux of the distribution throughout South-Western France of electric current obtained from water power in the Pyrenees and the Central Plateau, has been forwarded to the Department of Overseas Trade by the British Commercial Counsellor at Paris.

The *Journal* states that there is no doubt that the electrification of the South-West and of the railways by which that district is served will result in a considerable fall in the Bordeaux coal trade. It is true that the electrification of the Paris-Orleans Railway will only have a remote and limited effect on the traffic, but it is not the same with the Midi Railway. Within a few years it is estimated that the tonnage taken by the line may diminish by 250,000 tons, 15 per cent. of the present figures and 9 per cent. of the total imports. The diminution will be accentuated by the increasing output of the French collieries, which have been enabled, by reduced railway rates, to sell their coal in districts which have depended hitherto on the imported product.

The electrification of the South-West, on the other hand, will in the long run contribute to the development of agriculture, industry and commerce in the district, with favourable results to the seaborne trade of Bordeaux. The town is surrounded, at a distance ranging from 200 kiloms. to 250 kiloms., by groups of hydro-electric stations, the capacity of which, amounting at present to more than 200,000 kilowatts, is shortly to be increased to 400,000 kilowatts, and in the future may reach 1,500,000 kilowatts. There are also, not far from Bordeaux, large lignite fields, which might be used for the supply of great thermic stations.

It appears, therefore, that Bordeaux is more favourably placed than any other French port for the creation and development of industries, requiring cheap electric power and the resources of a great port for the importation of raw materials and the exportation of manufactured products. This applies in particular to the heavy electric industries, such as those treating zinc by the electro-thermic or electrolytic process, and those refining nickel or zinc by electrolysis, which consume a moderate quantity of current per ton of metal. Among the electro-chemical industries, the manufacture of carbide and calcium cyanamide, as well as of their by-products, would obtain particularly favourable conditions at Bordeaux.

The conclusion arrived at in the article is that the port of Bordeaux may find elements of increasing prosperity in the electrification of the South-West, but that the development of the electrical industry is hampered by the financial charges, which fall on enterprises for the utilisation of water power and the installation of distributing lines, as well as on certain branches of the electro-metallurgical and electro-chemical industries. It is for that reason that the managing board of the port has associated itself with the resolutions adopted by the 1923 Water Power Congress at Grenoble, recommending a reduction in taxation or a better distribution of these charges.

It is also announced in the local Press that the Midi Railway Company is about to push on its electrification programme, which had been momentarily abandoned. It is stated that several lines will be completely electrified; among others that from Pau to Laruns and from Pau to Bedous, with an extension to the international frontier station at Los Aranones. The latter line will be operated in the course of 1928. Work is making rapid progress, and at the present time the rails have been laid and stations are being built.

THE Mersey Railway Company carried 380,000 more passengers last year than in 1925, but at an average fare of 3·29d. per passenger, as against 3·64d. There was a saving of 14,000 train miles, but fuel cost £17,282, as compared with £12,167, and pumping £17,283 instead of £12,704.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Industrialists Dismayed.

THE threatened surrender of the Birmingham–Worcester Canal by the Birmingham authorities, as reported in my letter last week, has roused not only Midland industrialists, but also Bristol traders to action. They are alarmed and dismayed at the turn of events, realising that the first consequence of a definite refusal on the part of the City Council to take any part in promoting a scheme for the maintenance of the canal will be the closing down of the Sharpness and Birmingham navigation scheme. The Gloucestershire and Sharpness Navigation Company has sustained serious annual losses for several years past, and at the last meeting of the Council of Inland Waterways the managing directors of the Gloucester company definitely stated that this loss could not be carried any longer. A further consequence of the closing of the Birmingham and Worcester Canal will be to place the Severn Navigation Commissioners in an extremely difficult position. This body has already incurred serious liabilities, and is at the moment in dire straits for funds to procure adequate dredging machinery to keep the Severn in fit condition for boat traffic. Midland traders know that the canals have had the effect of securing for them relatively cheap railway rates. There is a real fear amongst them that immediately this canal is closed, railway rates will be increased, and this fear is justified by a comparison of the existing rates between Birmingham and the Bristol Channel and Birmingham and the Mersey. In relation to distance, the rates from the Bristol Channel, because of the canal alternative, are substantially lower. In this connection, the matter is also one of importance to Bristol traders. This week at a special meeting of the Council of the Bristol Incorporated Chamber of Commerce and Shipping, the subject was discussed and realising the very great importance, especially from the railway rates point of view, of maintaining the canal, a resolution was passed pledging the members to do all they can, in co-operation with the Bristol Docks Authority, to persuade the Birmingham Corporation to postpone any decision, in order to allow further consideration by the various interests affected. Whether the representations now being made by this and other bodies to the Birmingham authorities will have the desired effect is problematical, but it is hoped that a way out of the difficulty will yet be found, and that at least the present waterway will be maintained.

Industries Fair: More Space Needed.

It is evident that, to meet the growing demands of the heavy industries, further extension of accommodation will have to be made at Castle Bromwich for next year's Industries Fair. The floor space was increased very substantially this year, but the evidence that has been accumulated during the course of the Fair has made it abundantly clear that more space is needed. The electrical section, which was only started as a section a year ago, is one-third larger, and there have been many demands from all classes of firms for more space. In the case of one firm alone application has been made for four times its present accommodation. The Fair Management Committee, it is understood, is consequently contemplating increasing the floor space by a further 150,000ft. While no official announcement has been made, it is believed that plans are being considered, and a definite statement of intentions may be expected in the near future.

General Conditions.

There has been no material change in the market situation in the Midlands and Staffordshire since last week. There has been no expansion of demand and no relaxing of the determination to maintain the existing level of prices. Buyers and sellers are marking time, and the business passing is of small dimensions and merely for current consumption. A stimulus to business is expected from the Industries Fair, encouraging orders having been placed by home and overseas buyers with local manufacturers and engineering firms.

Raw Iron.

The conditions that have deterred buying in the pig iron department still persist. The coke ovens are still giving an insufficient output to meet the requirements of the blast-furnaces. Such is the excess of demand over supply that prices 30 per cent. above those which ruled at the beginning of the year are being paid for spot lots. No furnace coke is available now at less than 21s. at the ovens. It is not surprising therefore that smelters are clinging stubbornly to their selling prices. Consumers, though they realise that it is unlikely that values will fall in the near future, buy only small lots for immediate use. There is no real activity in any department. Some inquiry for forge pig is in evidence, but it is not so urgent as to overcome the opposition to the present basis of values. The output of foundry qualities is going mainly in satisfaction of old contracts. Midland foundrymen expect that by the time they are forced to come on the market for any considerable supplies, they will be able to buy to better advantage than they can now. While Derbyshire No. 3 foundry iron is quoted up to £4 5s., and even £4 7s. 6d., business is stated to have been done at £4 2s. 6d., furnaces. Northamptonshire foundry is quoted £4 2s. 6d., but for forward business £4 is readily accepted. Basic pig makes about £4 5s. at furnaces. Imports from the Continent are supplementing the home production to a considerable extent. East Coast hematite is plentiful. Mixed numbers are offered at about £4 8s. on rail. The effect of high basic costs is to retard business in the intermediate and finished branches.

Steel.

Midland steel makers, especially in the South Staffordshire area, are very busy with orders for immediate requirements. They report, however, that there is very little forward buying. Producers of steel have still substantial orders unfulfilled. In some cases, however, where six to eight weeks were required for delivery at the beginning of the year, orders are now sought with the promise of delivery in two or three weeks. This is a reminder that the arrears which had to be tackled after the stoppage are being worked off very much faster than new business is being placed. Prices still rule high, but with fuel prices at their present level steel users are compelled to put up with the position. Angles and joists are firm at £7 17s. 6d. to £8, ship, bridge and tank plates command £8 17s. 6d. upwards, boiler plates £11 10s. For small bars £8 15s. is paid, while native billets cannot be secured at under £7. Continental values generally are a little firmer. The recent prices asked by French and Belgian makers did not permit of profit making, and continental makers have evidently decided to call a halt. Steel billets are quoted at £5 12s. 6d. and steel bars at £6 5s. A Charleroi firm this week quoted steel joists at £6 5s. delivered. Midland constructional engineers are fairly well employed, and report that business is encouraging. Re-rollers are not so busy as they have been, but inquiries are quite numerous.

Finished Iron.

Staffordshire bar iron makers, with the exception of those turning out marked bars, are finding business difficult to obtain. Lancashire makers are competing strongly for the Crown bar business, and have reduced their quotations to £11 15s. Several Staffordshire firms, to meet this, have shaded the recognised figure of £12 by half-a-crown. Neither Lancashire nor Staffordshire makers, however, appear to be booking many new orders. Common bars used by the Black Country nut and bolt and fencing makers have fallen 5s. per ton, being now obtainable at £10 15s. Only a small amount of business is being received by local producers, the bulk going to Belgian firms, which can deliver into the district at £6 2s. 6d. Tube makers are taking fair quantities of wrought iron gas tube strip, and the price of £13 5s. is maintained with ease.

Sheet Values.

Competition for an inadequate volume of business in the galvanised sheet trade has led to further cuts. The general quotation was this week £15 2s. 6d., or 2s. 6d. less than a week ago. Business has, however, been done at a lower figure.

Electrical Equipment Order.

Some valuable orders for electrical apparatus for London and Birmingham have just been received in Wolverhampton. The contracts which go to the Electric Construction Company, Ltd., Wolverhampton, are:—For Birmingham Corporation, one 1000-kilowatt traction rotary converter, complete with transformer; one 1000-kilowatt lighting rotary converter, complete with transformer; and two 750 kilowatt lighting and traction rotary converters complete with transformer. For the London and Thames Haven oil wharves, three 350-kilowatt, 250 r.p.m., direct-current generators for coupling to Petter crude oil engines.

Unemployment.

The number of unemployed in the Midlands has decreased in one week by 12,961, the current total of 137,189 comparing with 150,150 for the previous week. In a fortnight there has been the substantial drop of 15,935. Birmingham shows a decrease of 4714, Smethwick 835, and Coventry 216. The fall has been general throughout the district, the only areas showing increases being Wednesbury, where the figures have advanced by 27, and Worcester, where they are up by 11.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Improvement in Engineering.

A SOMEWHAT more hopeful view of the position in the engineering industries is taken by the Manchester Chamber of Commerce in its review of general industrial conditions during the past month. Engineering firms, it is pointed out, have received more inquiries, and some of them have more actual orders in hand. Steel makers have decided to bear the new addition to railway rates themselves, and it is expected that that will help engineering firms. The heavy electrical section holds large orders for generating plant, but firms in other branches of the electrical industry are not, as a rule, well employed. In textile machinery the conditions vary, some makers being engaged on good orders, while others have not enough to do. New machine tools are not much in demand, but those who cater for motor manufacturers are fairly well engaged. The boilermaking industry is dull, but marine engineers are getting more work.

Locomotives and Fuel Economy.

Suggested economies in the consumption of coal in locomotives were discussed at the last meeting of the Manchester and District Association of the Institution of Civil Engineers in the course of a paper by Mr. J. Bean. The author's estimate of the quantity of unconsumed coal in smoke-box ashes during the last twenty-five years aggregated some 87½ million tons, or a yearly average of 3½ million tons. There is thus an important field for economy in the operation of what was described as an expensive machine to maintain in commission. Sixty-eight per cent. of the 3½ million tons of unused coal referred to would, said Mr. Bean, be usable in a suitable gas producer. With a view to effecting economies in the consumption of coal in locomotives, a series of careful tests had, the author said, clearly shown that locomotive fires could be lighted without the production of smoke and with the use of a smaller quantity of coal in the fire-box.

Success under Difficult Conditions.

In its review of current conditions in the engineering industries and its review also of the effect of the coal dispute, the address of Mr. Loris E. Mather, at the annual meeting here on Monday of Mather and Platt, Ltd., was distinctly interesting. The influence of the dispute on power and lighting, so far as the company's works were concerned, was infinitesimal, as supplies of electrical current by the Manchester Corporation were maintained unimpaired, at a very slight increase in cost. The greatest difficulty the company experienced was in obtaining supplies of steel castings. The volume of orders was, however, very materially affected, and such as had been taken during the last few months had, in many cases, been taken with very little margin for profit. Mr. Mather expressed himself as by no means pessimistic regarding prospects for the present year. During the last few weeks, he said, they had seen signs of a revival in the cotton trade, the prosperity of which had a considerable effect upon the firm's business; the collieries were beginning to make inquiries for electrical and pumping plant; while municipal contracts for extensions to electricity and pumping stations continued to be placed, although the competition was keener than ever. Trade with overseas countries, with one or two exceptions, had been disappointing, although he regarded that as all the more reason for anticipating better times this year. Mr. Mather made an interesting statement with respect to the supply of machinery to Russia, some considerable contracts having been secured by the company. All the contracts had been on a partial credit basis, payments had been received immediately when due, and they were quite prepared to take further contracts on similar terms.

Re-payment of Excess Capital.

The re-payment of capital in excess of its requirements has been decided upon by the directors of Francis Shaw and Co., Ltd., engineers, Manchester, the proposal being to pay off the holders of the 62,000 £1 preference shares and to cancel the issue, repaying, in addition, 2s. 6d. on each of the 88,512 fully paid ordinary shares and the 2760 employees' shares, the nominal value of these thus being 17s. 6d. each. In 1919 the company gave a share bonus of 500 per cent., and in June of the following year was transformed into a public concern.

A Works Department for Salford?

The Salford City Council is to be asked to appoint a special committee to consider the question of establishing a works department, the function of which will be to furnish tenders in competition with private concerns for the execution of works of public utility carried out by the Corporation that are usually let by contract.

Non-ferrous Metals.

All sections of the market for non-ferrous metals have continued the process of recovery which set in some weeks ago. Transactions in tin during the past week represented a considerable gain on the previous week, and after a certain amount of reaction closed the week at an advance of from £5 to £8, according to position, compared with the prices at the time of writing my last report. There has, however, been a fairly substantial setback in this section of the market during the early days of the present week, although, even so, prices for spot metal are in the neighbourhood of £3 per ton higher than they were a week ago, while compared with the beginning of last month the gain is something like £16. Buying of copper has been particularly heavy, and much of the business has been on industrial account, although speculators have been active. Here, again, some of the advance has been lost in the opening sessions of this week. The turnover in the case of lead has been lower than in the previous week, although the latter figures were exceptionally heavy; prices, however, in this section are about 10s. per ton higher. Spelter has been firm, and on balance is rather higher than a week ago, with a larger quantity of the metal changing hands.

Iron.

The demand for pig iron on the Manchester markets shows no sign of expanding as yet, and if there is not actually in force a "buyers' strike," there is in effect something closely approaching it, for it is very clear that users are not disposed to come on for any important quantities whilst prices remain at their present level. The result is that actual transactions are on a small scale, and relate primarily to filling immediate or early needs, contract bookings of any note being conspicuous by their absence. So far, however, there is no indication that a period of lower prices is approaching, in spite of the fact that there are reports of certain makers of Midland brands who are ready to accept orders at prices that are slightly below the general level. Staffordshire No. 3 pig iron is quoted here this week at 92s. 6d. per ton delivered into the Manchester area, whilst Derbyshire makes keep steady at about 93s., with Middlesbrough at 95s. 6d. and scarce, Scottish at 107s. 6d., West Coast hematite at 97s., and East Coast at about 98s. The demand for Lancashire bar iron is still very quiet, but prices remain at £11 15s. for Crown quality and £10 15s. for seconds.

Steel.

Similar conditions prevail in the steel market, and buyers are extremely slow in coming forward with orders at the existing level of prices. The general feeling of the market this week has been of a rather depressed character, and while the consensus of opinion favours the view that lower quotations would bring in a heavy volume of buying, there are some who incline to the view that the weight of business waiting to be placed is less than is generally believed. Prices vary according to delivery, and the position of producers from the point of view of orders, but joists and sections may be taken as from £7 15s. to £8; tank plates from £8 15s. to £9; boiler plates at about £11 10s.; general plates at £8 12s. 6d. to £8 15s.; and basic bars at about £9 per ton; with small re-rolled bars in slow demand, but unchanged also at £9. Sellers of con-

tinental steels are not booking any orders of importance, and inquiry on the whole keeps inactive. Values, however, are increasingly steady at £6 to £6 2s. 6d. per ton for steel bars; £6 2s. 6d. to £6 5s. for joists and sections; £7 10s. to £7 12s. 6d. for Siemens plates; £7 5s. for ordinary plates; £5 10s. for sheet bars and £5 5s. to £5 7s. 6d. for billets—for cash against shipping documents, and including delivery to users' works in the Manchester district. Galvanised sheets have shown no further easing off since last week, and values are about £14 17s. 6d. per ton f.o.b. for 24 gauges, with a fair trade with the Indian market.

Scrap.

In some quarters a rather better tone has been reported in the market for non-ferrous metal scrap, and quotations are steadier in some cases in sympathy with the new metals. Clean light copper scrap is offered at £57 10s., selected gun-metal scrap at £52 10s., zinc scrap at £25 to £26, scrap lead, £26 to £27, and selected heavy yellow brass at £45 for sorted qualities delivered to buyers' works.

BARROW-IN-FURNESS.

Hematite.

Although the market shows a tendency to be on the quiet side, makers are very busy trying to cope with demands for iron, and it is as much as they can do to keep pace with the requests for deliveries. There is still lost time to make up, and when this is achieved, then production will settle down to normal. The question is what the normal is going to be. There is some excuse for slight optimism on the grounds that the engineering trades generally are experiencing better conditions, and this fact points to a steady demand for hematite pig iron. Some of the present hesitation is no doubt due to some customers holding back the placing of orders for forward deliveries in the hope of lower prices ruling. More furnaces are going in in the district, and one in Cumberland is devoted very considerably to the production of ferro-manganese, which is in good overseas demand. Better qualities are still in request, and deliveries of late have been substantial.

Iron Ore.

The iron ore trade in the district is feeling the improvement, and more ore is being brought up than has been the case for some years. There is a tendency for the trade in native ores outside the district to improve, as was to be expected. Foreign ore is in steady demand, and likely to continue so.

Steel.

Steel makers are busy at present, and the mills at Barrow and Workington are active. At Barrow, in addition to the hoop mills, the small section mills are busy. For the latter, special high-grade billets are required, which are produced at the Barrow Steel Works, of which the small section mills are a branch.

SHEFFIELD.

(From our own Correspondent.)

Waiting for the Revival.

THE Sheffield steel trade is still anxiously awaiting that revival which, during the closing stages of the coal strike, was regarded as a probability of the near future. Much greater progress in this direction is apparently being made in the Cleveland and Midland areas than in the Sheffield district, where the outlook is anything but satisfactory. So far as the heavy side of the trade is concerned, there is little change to report on the week. The output of the furnaces has shown some small increase, and there is good volume of work on hand, which is sufficient in some cases to last until the end of the present quarter. There is still a general complaint, however, of lack of new business. While numerous small orders are coming to hand, few contracts for large tonnage are being placed, so that, when the present accumulation of work has been cleared off, there is no certainty of finding an outlet for the output. As additional blast-furnaces are being started in various centres, the production of pig iron promises to be on a large scale by the end of the month, and, if prices could be reduced to pre-war level, a big buying movement throughout the iron and steel industry would probably be stimulated. Producers of pig iron state, however, that they cannot reduce their quotations until coke is cheaper, and at present the position of that essential is stronger rather than weaker. There is, however, a feeling that the abundance of some classes of coal, and the cheapness of slack, will have an effect on coke prices before long. A declining tendency in the receipt of orders is reported by the rolling mills. In a few cases, full time working is maintained, but there is a general complaint that individual orders are too small in bulk to be remunerative.

Ship and Railway Orders.

Several interesting orders, booked by Sheffield firms or their subsidiaries, have been reported during the week. John Brown and Co., Ltd., are to build at Clydebank a packet steamer for the Canadian Pacific service on the British Columbian coast. The vessel will be engaged in the short but important run between Vancouver and Nanaimo. It will have a gross tonnage of 1000, and will be specially adapted to carry 50 motor cars in addition to 1200 passengers. It is to be delivered ready for service by March 1st next year. The Leeds Forge Company, Ltd., and the Metropolitan Carriage, Wagon and Finance Co., Ltd., Birmingham, are to share with a Czecho-Slovakian firm an order for 60 first-class all-steel passenger coaches for the Egyptian State Railways; and for the same service the Metropolitan Carriage, Wagon and Finance Co. is to build 250 all-steel covered 10-ton wagons. The India Store Department is inviting tenders for large quantities of railway materials.

Coal Working Rights.

Another instance of the value of the Mines (Working Facilities and Support) Acts is forthcoming from this district. The Askern Coal and Iron Co., Ltd., of Askern, near Doncaster, is applying for ancillary rights to work 630 acres of land for coal in the parishes of Askern, Norton, Campsall, Sutton, Fenwick, Daywood, and Moss, in the West Riding. The application is to be heard by the Railway and Canal Commission on April 7th. There was a preliminary mention of it last week, when counsel for the colliery company said that the parcels of land were intermingled with an area of 8000 acres under lease to the company. They were so small that they could not be worked by themselves, the largest not exceeding 55 acres, and, in view of that, the minerals were in danger of being left permanently unworked. The coal would be worked from the existing shafts to Askern pit. It was estimated that 5000 tons of coal per day would be raised from the area.

Cutlery and Plate.

The reports from the cutlery and plate branches are generally unfavourable, and in only a small number of cases do firms appear to be even fairly busy. The electro-plate and silver side is quieter than cutlery. The ordinary trade in cutlery, distributed through stores and shops, is very depressed, but business is better in two respects of very different kinds—on the one hand in contracts for the equipment of hotels and restaurants, and on the other in work of a special character, such as penknives for distribution in connection with advertising schemes and coupons. Some of the little firms are well supplied with work under the latter head. Formerly, much of it went to Germany, but Sheffield has gained it owing to its local makers being able to quote prices as low or even lower than those of their continental competitors. At the meeting of the Sheffield Advisory Committee last week, there was some discussion with regard to what are known as "kick" scissors, the small implements which are fitted into some pocket knives. Although it was stated that these scissors are being made, and successfully, in Sheffield, the majority of those used are bought in Germany, and the question arose to as whether an application should be made, under the new Merchandise Marks Act, for their compulsory marking with the place of origin. Certain manufacturers are in favour of this compulsion on the ground that it would force users to get the articles made at home, but there are many opponents who contend that the home-made scissors would be much more expensive than the imported ones, and would necessitate an increase in the price of the finished article. There have been increases in the price of the scissors already, owing to the war and the Safeguarding Duty, and their use is now on a much smaller scale than formerly.

Stainless Knife Handles.

New uses are continually being found for stainless steel, and one of the latest is its employment for the manufacture of table knife handles. The task has not been achieved without difficulty, owing to soldering troubles due to certain natural properties of the stainless material, and some attempts have been abandoned. Now, however, one firm of handle and ferrule manufacturers for the trade claims to have perfected a process of soldering by which all-stainless knives can be produced on a large scale as a commercial proposition. The new all-steel knife is said to be many times stronger than the steel and nickel silver knife, and the handles are lighter.

Two Water Schemes.

Waterworks extensions, carried out at a cost of £20,000, were formally opened at Wath last week. The works consist of an additional bore-hole, a new pumping plant, engine house, enlargement of pumping station water tower, sand filters, and four miles of new mains. A provisional agreement has been entered into whereby the water resources of Mexborough are to be supplemented by a supply from the Sheffield Corporation, at the price of 1s. 3d. per 1000 gallons. The Mexborough Council will carry out works, estimated to cost £40,000, which will include the laying of a 9in. or 10in. main from Sheffield to Mexborough for the carriage of the water, and the construction of a reservoir at Mexborough. This reservoir will be divided into two parts, one of which will provide an emergency supply for three days.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Still Expanding.

THE trade position in the North of England is very encouraging. The expansion is still going on in practically all sections of industry, though it would undoubtedly make quicker progress if the iron and steel manufacturers were able to supply the needs of the shipbuilding yards, which have not only a good deal of work on hand, but more orders coming forward. This week Sir W. G. Armstrong, Whitworth and Co., Ltd., Walker-on-Tyne, have booked an order for two tankers for British Tankers, Ltd., of about 10,000 tons each, to be engined on the Tyne. This order makes fourteen vessels that the firm has to build, including two submarines for the Jugo-Slav Government, and exclusive of the battleship H.M.S. Nelson, which is expected to be completed in about two months' time. Swan, Hunter and Wigham Richardson, Ltd., Wallsend, have secured an order for five grain ships for the Paterson Steamship Company, of Port William, Ontario. They are to carry grain from the Canadian Lakes. Numbers of inquiries for new tonnage are in circulation, and altogether the prospects of the shipbuilding trade are brighter than for many years past. Unfortunately, operations at most of the yards are seriously hampered because of the slowness with which steel manufacturers are supplying the materials for the vessels for which contracts have been placed. There is no ground, however, for the allegation that has been made that shipbuilders are paying premiums to steel makers to get quick delivery of materials.

Cleveland Iron Trade.

The lull in business in the Cleveland pig iron trade continues. There is no lack of confidence that a busy year lies ahead, but prices are still so substantially above pre-strike levels that buyers adhere to the view that further adjustments must take place, and they are consequently doing no more than purchase from hand to mouth, deferring for a more favourable moment the fixation of the usual spring contracts. Sellers, on the other hand, have no reason to cut prices, and with coke prices at their present level there is little profit in pig iron manufacture. Moreover, the makers are getting rid of all their output without any difficulty. They have only a small surplus for disposal after meeting the needs of the steel plant, and they still have many old contracts to complete. Very little Cleveland foundry iron is being shipped abroad, but the home market is sufficient to absorb all that comes on offer, and, in fact, No. 1 and No. 4 forge are both very scarce. No. 1 Cleveland foundry iron is 87s. 7d. per ton; No. 3 G.M.B., 82s. 6d.; No. 4 foundry, 81s. 6d.; and No. 4 forge, 81s. Export prices are 6d. per ton more than the f.o.t. price.

Hematite Pig Iron.

There is a good deal of foreign inquiry for East Coast hematite pig iron, but sales are relatively few. The fact is that prices are too high. However, there is now a rather easier tendency, and East Coast mixed numbers are offered at 89s. per ton, with a possibility of business at 88s.

Ironmaking Materials.

Consumers of foreign ore, having replenished their stocks by receiving deliveries against old contracts, are holding off the market, but a firmer feeling is apparent, and sellers are unlikely to renew contracts over periods at figures now ruling. Best Rubio ore is put at 22s. 6d. per ton c.i.f. Tees. Sellers of Durham blast-furnace coke are in a very strong position, and predict a further rise in prices. Consumers are reluctant to pay ruling rates, which they declare are much too high, but they are urgently in need of heavier supplies, and sellers are unyielding. Good medium qualities are 27s. 6d. per ton, delivered at the works.

Manufactured Iron and Steel.

The position in the manufactured iron and steel trade shows no material change. All the works are being ceaselessly harried for delivery, and they are working at high pressure. Stocks are non-existent. Buyers, however, are not buying far ahead, evidently believing that prices may ease, but this hope can only be realised if fuel prices recede. In the meantime, manufacturers take a firm stand, and prices are unchanged.

Iron and Steel Exports.

The inadequacy of the output of pig iron is reflected in the export figures for the Cleveland district during February. Needing most of the iron produced for their own steel works, makers have little to sell for export. Thus, although the shipments of pig iron from Cleveland last month totalled 14,271 tons, as against 8178 tons in January, they were less than 50 per cent. of the pre-strike monthly average. Moreover, most of the iron shipped was sent to Scotland or South Wales, and only 4810 tons was shipped to overseas ports. In February of last year the foreign shipments of pig iron totalled 14,680 tons. The recovery in the finished iron and steel export trade has been more rapid. Pre-strike shipments averaged rather more than 60 000 tons per month. The figure fell to 16,318 tons in November last, and last month reached 47,973 tons, of which 35,371 tons went abroad. The biggest increases were recorded in the shipments to India, Egypt and Australia, and orders booked indicate that those countries will continue to absorb the bulk of the steel exported from this district.

The Coal Trade.

The month of March has opened with the cheering news in the Northern coal trade that a very large portion of the Danish State Railways' contract has come to this district. It is understood that 20,000 tons of Horden have been taken on the basis of 18s. 3d. per ton f.o.b., 10,000 tons and 20,000 tons of Lambton and South Hetton at 18s. 6d., and 15,000 tons of North Northumberland at 15s. 3d. to 15s. 6d. The prices are low, but much will depend on the ultimate freight conditions as to how the contracts work out c.i.f. The delivery is from April to June. The inquiry was for 100,000 tons, and it is not known whether the balance of 35,000 tons has been placed elsewhere or not. Foreign buyers continue to keep close touch with the market, but are not pressing definite business in the hope of seeing a further fall in values. Producers, however, continue to hold against making further reductions, as the prices already, in the majority of the districts, are below the cost of production. In many areas, in fact, output is being curtailed by short time working, but even then the supply is ample to meet all current requirements. On the whole, there is a good steady tone for best-quality steams, and a firm position for gas coals. Best Northumberland steams are well off for trade, and hold steadily at 17s. per ton, with second qualities at 15s. 6d. There is little movement in steam smalls, and prices of any grade are nominal at 10s. 3d. to 11s. Best Durham gas coals are firmly quoted at 17s. to 17s. 6d., while secondary gas are moderately well off, and hold to 15s. 6d. to 16s. Durham coking unscreened are in demand for home trade, but dull for export, and under ample supplies the undertone is weak at 15s. 6d. to 16s. The bunker trade is very slow, and all descriptions are pressed for clearance, good sorts at 15s. 6d., beats 16s. to 17s. The position in the coke trade is very satisfactory to makers, as requirements continue to exceed production, and values are firmly maintained. Gas coke is quoted at 23s. to 24s.; patent foundry coke, 26s. 6d. to 28s. 6d.; beehive and special coke, 30s. to 32s. 6d.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding—Small Output.

FOR various reasons the output from Clyde shipyards remains low and would tend to give a false impression of the state of the industry. Most of the vessels near the launching stage last year were put into the water, while work on others was held up and is still delayed owing to an insufficient supply of materials. Further, a considerable amount of tonnage has been put on the order books during the past two to three months, which should mean greatly increased activity in the near future. The total tonnage launched during February amounted to fourteen vessels of 8008 tons aggregate, while the total for this year to date of fifteen vessels of 13,217 tons aggregate is the lowest on record for the period. Of the tonnage launched during February more than half the total was accounted for by the steamer Dalcairn, cargo vessel, 4610 tons, built by Messrs. Scotts, of Greenock, for the United Steam Navigation Company, Ltd., London. Contracts reported during the month included two motor ships (cargo) each of 9300 tons, for the Federal Steam Navigation Company, London, instead of a motor liner of 17,000 tons ordered previously; a cargo steamer of 3000 tons for colonial owners, and a number of small craft.

Steel.

New business in steel material continues quiet. Many consumers have, of course, covered requirements over a period and arrears of orders are still to be overtaken, consequently the majority of the steel works are working full time, and are still unable to satisfy customers in the matter of delivery. Few, therefore, if any, could undertake to supply material promptly. Prices are unchanged.

Steel Sheets.

The demand for black and galvanised sheets is comparatively good. Makers of light gauges have booked a fair volume of business for export delivery, while for home delivery most descriptions are well booked. The increased costs of raw materials have caused a steadier tendency in sheets.

Iron.

The inquiry for iron has not increased, and the works are, in many cases, only partially engaged. The home quotation, however, is still unchanged at £11 15s. per ton for Crown quality. The re-rolled steel departments are busier than the iron, but here again there is room for improvement. Re-rolled steel quotations are round about £8 10s. per ton home or export.

Pig Iron.

There are now twenty-eight furnaces in blast, and the demand may be gauged from the fact that supplies in most cases are ample, only some brands of foundry being somewhat scarce, owing to the difficulty in securing the desired quality. The general tendency of prices is slightly downward.

Coal.

The market for Scottish coal has not improved. Home demands for all purposes continue below normal, while new export business is extremely slow. Lanarkshire ells and splints have only moderate bookings, while the collieries in the Lothians are seeking orders for all descriptions of fuel. Fifeshire first-class steams are almost the only firm spot at present. Reports from all districts indicate a dearth of orders for washed materials, and despite lower prices, many colliery sidings are congested with loaded wagons of unsold washed fuels. Exporters of Scottish fuel attribute the lack of business to keen competition from Polish and also from North of England coals. In the home trade merchants still suffer from the presence of considerable quantities of American fuel.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Colliery Disaster.

THE worst disaster in the South Wales coalfield since the Senghenydd explosion in 1913, when 412 men lost their lives, took place this week at the Marine Colliery, Cwm, near Ebbw Vale, which belongs to the Ebbw Vale Steel, Iron and Coal Company. An explosion occurred about two o'clock on Tuesday morning, in the Big Vein seam on the east side of the colliery, there being at the time 115 night-shift men in the colliery. On Tuesday night an official list stated that the number of men unaccounted for was fifty-one, while five had been brought up dead and eleven alive, very little hope being entertained for those unaccounted for. A remarkable fact is that no one on the surface felt the explosion and no damage was done to the pit gear, the shaft or cages. The seat of the explosion was about a mile from the pit bottom. Big falls took place underground as the result of the explosion, and, together with the presence of gas, greatly impeded the work of rescue, which was entered upon immediately by officials and men alike, with the utmost heroism and disregard for their own safety. Those miners who were saved were mostly on the west side of the colliery, the men on the east side being hemmed in by flames, which followed the explosion. The work of rescue was so dangerous that the members of one party which went down were all gassed and a second party had to be organised to rescue them. Mr. W. H. John, the agent at the colliery, who had gone into the workings to give assistance to the unfortunate victims, was himself rescued in the nick of time. He was found lying on his face gassed, and is in a very serious condition. He was rescued at the third attempt.

LATER.

On Wednesday morning sixteen bodies were brought up from the pit. Very little progress has been made towards reaching the men in the Black Vein seam, where twenty-eight men were known to be imprisoned. Men have been working in relays, but exploration is extremely difficult. The falls are heavy, there being thousands of tons of *débris* in the Black Vein district as the result of the explosion. The cause of the explosion is so far a mystery, and no definite theory is advanced pending the actual seat of the explosion being reached and investigations made.

Coal Trade Outlook.

The opinion is growing that the outlook in the steam coal trade is improving. Certainly the inquiry is better, but collieries are not yet feeling the full benefit of the business that is now available, owing to the fact that continued bad weather upsets their calculations by driving tonnage out of position. The arrivals over the past week-end were disappointing, and were considerably short of expectations. The consequence is that many undertakings are hard pressed to maintain regularity of work at the pits, and are not in a good position to quote for fresh business on the market. Still there is no doubt that a fair amount of business is held by many exporters who in some directions find it difficult to obtain suitable tonnage for their requirements. Tenders had to be in on the 1st inst. at Cairo for 100,000 metric tons of Welsh large coals for the Egyptian State Railways for delivery over March, April and May. The order has not yet been actually placed, but the lowest tender put in is that of 33s. 5d. per ton, c.i.f. Alexandria, by Tabb and Burletson, the next lowest being 33s. 8d. by Tennants, and 33s. 10d. by Furness, Withy and Co. The tenders have to hold good for ten days. Some definite news is awaited regarding the tendering for the patent fuel and coal requirements of the Algerian State Railways, but from the preliminary information to hand it is feared that little of the order will come to South Wales. From all accounts, German patent fuel manufacturers have undercut this district to the extraordinary extent of about 5s. to 6s. per ton. The order for 60,000 tons of large coal for the Norwegian State Railways has gone to the North, but the Greek State Railways have bought a cargo of steam coal and one of patent fuel from South Wales. An interesting inquiry is that from the Belgian State Railways for 90 000 tons of large coal, 30,000 tons of through coal, 25,000 tons of small coal, and 5000 tons of patent fuel for delivery over the next three months. It is also reported that tentative inquiries are circulating respecting coal requirements for the United States, in view of the possibility of strike troubles in that country next month. One inquiry is for 20,000 tons of nuts and beans for delivery from April to August.

LATER.

Definite news has come to hand that the Algerian State Railways contract for patent fuel has gone to German competitors, the quantity taken being 91,000 tons for delivery over the remainder of this year. South Wales manufacturers were undercut by several shillings. The Algerian State Railways have, however, contracted for the supply of 32,000 tons of sized coals from South Wales. The order for 20,000 tons of best Welsh large coal for the Madrid Laragosa and Alicante Railway of Spain has been placed.

Foreign Coal Imports.

Complete returns are now forthcoming regarding the foreign coal importations since the commencement of the national strike in this country. It is of special interest to note that supplies came to this country from no less than thirty-two different countries. The total which came to South Wales was 1,684,707 tons, of which 838,602 tons were for the Great Western Railway Company, 341,160 tons for the London, Midland and Scottish Railway, 66,407 tons for the Government, and 438,538 tons for general industrial purposes. Cardiff received 610,478 tons; Barry, 461,653 tons; Newport, 211,943 tons; Penarth, 70,642 tons; Swansea, 249,460 tons; and Port Talbot, 80,531 tons.

Iron and Steel and Tin-plates.

The iron and steel works at Dowlais belonging to Guest, Keen and Nettlefolds, Ltd., resumed operations on a full scale on Monday after being temporarily closed down in May last as the result of difficulties arising from the coal strike. About 1000 men were already at work, but the return to normal working will mean employment for over 3000 men. The Gurnos tin-plate works, which were idle last week as a consequence of a dispute, restarted work on Monday. About 200 men struck work in an unconstitutional manner on account of the transfer of a man from one department to another.

Current Business.

There is a rather better demand for prompt shipment and a very confident feeling prevails that an improvement will be seen in the coal market, if only tonnage comes along more freely. Shipments last week fell off to the extent of 38,000 tons, due almost entirely to tonnage being held up by bad weather. The tone of the market is certainly steadier, although it cannot as yet be said that this improvement is manifest in actual prices, which remain on the whole about the same as last week, viz., best Admiralty large 22s. to 23s., with superior smalls in the neighbourhood of 15s. Patent fuel remains about steady. The Crown Company has reopened its works at Port Talbot. These works have been idle for twelve months. Their reopening means employment for about 400 men.

Obituary.

Mr. Robert Williamson, a leading figure in the ship-repairing industry of South Wales, died at his home at Malpas, near Newport, on Saturday of last week. Mr. Williamson, who was seventy-three years of age, was a director of Mountstuart Dry Docks and Shearmans, Ltd., one of the largest ship-repairing combines in this district. Mr. Williamson was a native of Rothesay, Isle of Bute, and was apprenticed to William King and Co., marine engine builders of Glasgow. He came to South Wales in 1883, and for a number of years past had rendered valuable service in negotiations between employers and representatives of the various grades of workmen. He was a member of the Institute of Engineers and Shipbuilders in Scotland and a member of the Institute of Marine Engineers of London. He received the honour of C.B.E. in 1918 for his services at the Mountstuart Munition Factory at Cardiff.

CONTRACTS.

THE First Garden City, Ltd., Letchworth, has placed an order for a 1000-kilowatt La Cour motor converter with Ateliers de Constructions Electriques de Charleroi (A.C.E.C.).

INTERNATIONAL COMBUSTION, Ltd., announces that its associates, S. A. Foyers Automatiques, Paris, have obtained the contract for the complete "Lopulco" installation for the Alost plant of the Société Générale de Scie Artificielle "Viscose." The normal rating of the boilers is 14,000 kilos. per hour, with a peak load rating of 18,000 kilos. per hour.

YARROW AND CO., Ltd., of Scotstoun, Glasgow, have recently received the following orders:—(*a*) For two boilers with a working pressure of 600 lb. per square inch, with superheaters and air heaters from the Castner-Kellner Alkali Company, Ltd.; (*b*) for a total of eight Yarrow boilers with superheaters and air heaters from the Burmah Oil Company, Ltd., the Assam Oil Company, and the Strand Palace Hotel; and (*c*) for four boilers and superheaters for the power station at Devonport Dockyard. The same firm has also in course of construction three additional high-pressure boilers for the Barking power station, and other Yarrow boilers for Canadian Pacific Company's vessels, for Portsmouth Dockyard, the City of London Electric Lighting Company, Ltd., &c.

IT is officially announced by the Great Western Railway Company that the following contracts have been placed:—(*a*) Supply of new steam launch, Messrs. Vosper and Co., Portsmouth; (*b*) overhaul of dredger Countess and grab hopper barge Mudeford, Thomas Diamond and Co., Ltd., West Side, East Bute Dock, Cardiff; (*c*) overhaul of ss. The Mew, Messrs. Philip and Son, Sandquay, Dartmouth; (*d*) supply of a 2-ton petrol-electric mobile crane for Nos. 6 and 8 transit sheds, Newport, Ransomes and Rapier, Ltd., Ipswich; (*e*) demolition and removal of buildings and machinery at Roath Basin, Cardiff, Mr. Maberly Parker, Cowbridge-road, Cardiff; (*f*) provision of new office accommodation at Chelsea Basin, Building and Public Works Construction Company, Ltd., County Works, Swindon; and (*g*) supply of electrically driven pumps for Landore, F. Pearn and Co., Ltd., West Gorton, Manchester.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

K. HOLST AND CO., of Westminster Chambers, 1, Victoria-street, London, S.W. 1, ask us to announce that they have opened a branch office at 10, Park-square, Leeds, of which Mr. H. E. Manning, B.Sc., who has been for several years on their head office staff, is taking charge.

THE NATIONAL BOILER AND GENERAL INSURANCE COMPANY, Ltd., the head offices of which are in National Buildings, St. Mary's Parsonage, Manchester, asks us to state that on and after March 5th the address of its London office will be Empire House, St. Martin's-le-Grand, E.C. 1.

THE BLUE STAR LINER ANDALUCIA.—The Andalucia, the second of three twin-screw geared turbine vessels built by Cammell Laird and Co., Ltd., Birkenhead, for the Blue Star Line, left her builders' works on March 1st and proceeded outside the Mersey for her speed and other trials. The trials were, we learn, satisfactory in every respect, and on their completion the vessel returned to the Mersey and sailed for London with a view to taking up her service to South America on March 11th. The Andalucia has a length of 510ft. between perpendiculars and a displacement of about 23,000 tons. She is a sister ship to the Almeda, described in our issue of December 31st, 1926, and has accommodation for about 180 first-class passengers only. A modern system of insulated spaces for carrying refrigerated cargo has been fitted.

ENGINEERING GOLFING SOCIETY.—The eighteenth annual general meeting of the Engineering Golfing Society was held, by permission of the Council of the Institution of Civil Engineers, in the Institution building, on Thursday, February 24th, the retiring captain, Mr. D. T. Powell, in the chair. The office bearers for the current year were elected as follows:—President, Sir Alexander Kennedy; vice-presidents: D. A. Stevenson, E. L. Mansergh, F. J. Walker, S. Price-Williams, G. Midgley Taylor, W. H. Shortt, E. W. Timmis, K. A. Wolfe Barry, W. L. Mansergh, S. R. Lowcock; captain, P. L. Riviere; honorary secretary and treasurer, H. P. Allison; honorary auditor, S. C. Lewis; elected members of committee: F. Bolton, W. A. Brown, C. S. Davidson, R. E. Docwra, H. G. Hale, R. J. M. Inglis, W. R. Manning, D. T. Powell, H. C. Siddeley.

HIGH-SPEED STEEL HACKSAW BLADES.—We have received from Sir W. G. Armstrong, Whitworth and Co., Ltd., some particulars of their "A.W." high-speed steel hacksaw blades for power use, which are made from material containing no less than 14 per cent. of tungsten, and in connection with which an improvement has recently been made in the method of grinding the teeth after hardening. These saws are made in sizes varying between 10in. to 24in. in length between centres, and they cost from two to three times as much as ordinary power hacksaw blades, but it is claimed that these "A.W." blades are more economical than ordinary blades made from steel containing from 1 to 2 per cent. of tungsten owing to the much greater output that can be obtained with them and to their longer life. We note, moreover, that the firm is prepared to re-sharpen those blades and that the process can be performed several times.

BULL-HEAD RAILS.—The British Engineering Standards Association has notified us of an alteration to the chemical composition specified in the B.S. Specification No. 9–1922 for Bull-head Railway Rails, an increase of 0·01 per cent. for sulphur and phosphorus having been agreed to for "ordinary carbon" and "higher carbon" rails made by the acid open-hearth process and also for phosphorus for "higher carbon" rails made by the acid Bessemer process. The revised figures are as follows:—Steel made by the acid open-hearth process (ordinary carbon), phosphorus 0·07 per cent. max., sulphur 0·07 per cent. max.; steel made by the acid open-hearth process (higher carbon), phosphorus 0·06 per cent. max., sulphur 0·06 per cent. max.; steel made by the acid Bessemer process (higher carbon), phosphorus 0·07 per cent. max. A slip giving the revised figures for insertion in existing copies of the specification may be obtained from the Association by forwarding a stamped addressed envelope to the B.E.S.A., Publications Dept., 28, Victoria-street, London, S.W. 1.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/–
(1) Spanish	18/6 to 21/–
(1) N. African	18/6 to 21/–
N.E. Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 7 6	—
No. 1 Foundry	4 14 0 to 4 16 6	—
No. 3 Foundry	4 9 0 to 4 11 6	—
N.E. Coast—		
Hematite Mixed Nos.	4 9 0	4 9 0
No. 1	4 10 0	4 10 0
Cleveland—		
No. 1	4 7 6	4 7 6
Silicious Iron	4 7 6	4 7 6
No. 3 G.M.B.	4 2 6	4 3 0
No. 4 Foundry	4 1 6	4 2 0
No. 4 Forge	4 1 0	4 1 6
Mottled	4 0 0	4 0 6
White	4 0 0	4 0 6
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	4 0 0	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	4 0 0 to 4 2 6	
Foundry Forge	3 13 0	—
(3) Derbyshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
Forge	3 18 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 2 6 to 4 5 0	
No. 4 Forge	—	—
Basic	4 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 17 6 (a); 5 0 6 (b); 5 4 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 15 0	—
Best	—	—
N.E. Coast—		
Common Bars	11 15 0	—
Lancs.—		
Crown Bars	11 15 0	—
Second Quality Bars	10 15 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	11 15 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	11 17 6 to 12 0 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	10 15 0	—
Gas Tube Strip	13 5 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¾in. and up	8 7 6	£8 0 0 to 8 5 0
Sections	7 17 6	£7 10 0 to 7 15 0
Steel Sheets, under 3/16 in. to ¼in.	12 0 0 to 13 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 10 0 to 16 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 0	—
Boiler Plates	12 10 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 10 0†	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0†	
Manchester—		
Bars (Round)	9 0 0	—
,, (Small Round)	9 0 0	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 15 0	10 15 0
Plates	8 15 0	—
,, (Lancs. Boiler)	11 10 0	—
Sheffield—		
Siemens Acid Billets	11 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	9 2 6	—
Intermediate Basic	8 12 6	—
Soft Basic	7 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	10 0 0	—
Midlands—		
Small Rolled Bars	8 15 0 to 9 0 0	
Billets and Sheet Bars	7 0 0 to 7 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 2 6	—
Angles	7 17 6 to 8 0 0	
Joists	7 17 6 to 8 0 0	
Tees	9 0 0	—
Bridge and Tank Plates	8 17 6 to 9 2 6	
Boiler Plates	11 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	20/– to 20/3
Block Tin (cash)	311 5 0
,, (three months)	299 0 0
Copper (cash)	56 2 6
,, (three months)	56 12 6
Spanish Lead (cash)	28 7 6
,, (three months)	28 15 0
Spelter (cash)	30 12 6
,, (three months)	30 17 6
Manchester—	
Copper, Best Selected Ingots	62 5 0
,, Electrolytic	63 7 6
,, Strong Sheets	86 0 0
,, Tubes (Basis Price) lb.	0 1 0¼
Brass Tubes (Basis Price) lb.	0 0 11¼
,, Condenser lb.	0 1 1¼
Lead, English	30 5 0
,, Foreign	28 17 6
Spelter	31 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10 per lb.	
Ferro Tungsten	1/6 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 10 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£36 2 6	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	15/–
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£16 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 12 6 scale 5/– per unit	
,, ,, 75 p.c.	£18 10 0 scale 6/– per unit	
,, Vanadium	14/9 per lb.	
,, Molybdenum	5/3 per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Cobalt	9/– per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	15/6
,, ,, Ell	16/6
,, ,, Splint	16/6 to 18/6
,, ,, Trebles	17/–
,, ,, Doubles	16/–
,, ,, Singles	14/– to 14/9
Ayrshire—	
(f.o.b. Ports)—Steam	16/6
,, ,, Jewel	18/6
,, ,, Trebles	17/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	14/– to 16/–
Screened Navigation	22/9
Trebles	17/–
Doubles	15/9
Singles	13/– to 14/–
Lothians—	
(f.o.b. Leith)—Best Steam	14/6
Secondary Steam	13/9
Trebles	16/9
Doubles	16/–
Singles	13/6

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		27/6
Household		*No quotation.*
Coke		31/6
Northumberland—		
Best Steams		17/–
Second Steams		15/6
Steam Smalls		10/6
Unscreened		15/6
Household		23/– to 30/–
Durham—		
Best Gas		17/3 to 17/9
Second		15/9 to 16/3
Household		23/– to 30/–
Foundry Coke		27/– to 27/6
Sheffield—		
Best Hand-picked Branch	40/–	
Best Selected House Coal	34/– to 35/–	—
Barnsley Best Silkstone	30/– to 32/–	—
Derbyshire Best Brights	30/– to 32/–	—
,, ,, House	28/– to 30/–	—
,, ,, Large Nuts	26/– to 28/–	—
,, ,, Small	18/– to 21/–	—
Yorkshire Hards	19/– to 21/–	—
Derbyshire Hards	19/– to 21/–	—
Rough Slacks	12/– to 12/6	—
Nutty Slacks	9/6 to 9/6	—
Smalls	3/– to 6/–	—
Blast-furnace Coke (Inland)	20/– to 25/– at ovens.*	
,, ,, (Export) f.o.b.		26/– to 27/–

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	22/– to 23/–
Second ,, ,,	21/6 to 22/–
Best Dry Large	21/6 to 22/–
Ordinary Dry Large	20/6 to 21/–
Best Black Vein Large	21/9 to 22/3
Western Valley Large	21/6 to 21/9
Best Eastern Valley Large	20/6 to 21/–
Ordinary ,, ,,	20/– to 20/6
Best Steam Smalls	14/6 to 15/6
Ordinary Smalls	12/– to 14/–
Washed Nuts	20/– to 23/–
No. 3 Rhondda Large	27/– to 27/6
,, ,, Smalls	17/6 to 18/6
No. 2 ,, Large	21/– to 22/–
,, ,, Through	18/– to 19/–
,, ,, Smalls	13/– to 14/–
Foundry Coke (export)	40/– to 45/–
Furnace Coke (export)	25/– to 30/–
Patent Fuel	27/– to 27/6
Pitwood (ex ship)	32/– to 32/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	37/6 to 40/–
Seconds	30/– to 32/6
Red Vein	27/6 to 29/–
Machine-made Cobbles	42/6 to 45/–
Nuts	47/6 to 52/6
Beans	42/6 to 45/–
Peas	22/6 to 25/–
Breaker Duff	8/6 to 9/3
Rubbly Culm	13/6 to 14/–
Steam Coals :	
Large	22/– to 23/–
Seconds	21/– to 22/–
Smalls	12/– to 14/–
Cargo Through	17/– to 18/–

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. † Latest quotations available.

(a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. * Open market price. Special price for pig iron producers, 19/– per ton at ovens.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Difficulties.

THE industrial stagnation shows no signs of giving way, and as unemployment is increasing and manufacturers generally find it difficult to tide over the financial crisis, it cannot be said that the outlook is encouraging, although every effort is being made to inspire confidence in the immediate future.—It is certain that more inquiries are being received, which implies that consumers are in need of material and are endeavouring to ascertain the trend of prices. Producers are so destitute of work that they are certainly making concessions, but it is believed that the bottom has been reached and that buyers will begin to place orders at an early date. That, however, is a mere supposition, and there is nothing to indicate a fulfilment of the hopes now being entertained of a recovery. The only encouraging feature is that the railway companies are distributing a number of orders for rolling stock, with the result that wagon builders are busier now than they have been for a long while past. A great deal is being said about the putting in hand of public works which are to provide relief for the unemployed, but so far nothing has been done, nor is it possible to do much, unless some arrangement can be made for the supply of German material on account of reparations, particularly for the execution of the vast programme of hydraulic works. It is obvious that there can be no hope of a permanent recovery until there is a general industrial activity at home, which hardly appears possible until the financial situation is definitely stabilised. It is recognised that even then there can be no prosperity unless manufacturers are able to recover the export trade which they lost as soon as the improvement of the franc deprived them of the advantages they enjoyed in foreign markets. Their capacity of production is far in excess of the country's needs. It is mainly for that reason that the Confédération Générale de la Production Française and the Association Nationale d'Expansion Economique have accepted the invitation of the Federation of British Industries to a conference in London to discuss various matters affecting the future of trade between the two countries.

Import Duties.

While it is stated that the new Tariff Bill, which is being introduced into the Chamber of Deputies this week, is not intended to insure an exaggerated protection of home industries, it is obvious that the duties all round will be appreciably increased, and for the first time the Government will be empowered to impose duties on raw material, apparently as a means of retaliation against countries which do not offer compensation. On coal, lignite and coke there is to be an import duty of 2 f. a ton, and anthracite will pay 5 per cent. *ad valorem*. As giving some idea of the character of the new Bill the duty on steam engines will range from 78 f. to 180 f. per 100 kilos., according to the weight of the machines.; steam turbines, 320 f. to 410 f. per 100 kilos.; locomotives, 160 f. to 180 f.; weaving machines, 180 f. to 210 f.; mowing machines, 110 f.; binders, 100 f.; boilers without tubes, 37·5 f.; tubular boilers, 105 f.; spare parts for machinery and transmissions in malleable iron and other castings, 84 f. to 180 f., according to weight; spare parts for machines in other metals, 215 f. to 600 f.; small engineers' tools, 30 per cent. *ad valorem*. The duties are calculated in a manner to obtain, as far as possible, the equivalent to an *ad valorem* duty on the actual value of the goods delivered in this country and approximating to the value of similar French goods at the same place. In many cases the duties are imposed on gross weight and not on the net weight as at present.

Shipbuilding.

The protest raised by machinery makers against the proposal of the Government to permit the free importation of marine engines and machinery of all kinds for the equipment of ships built for export, has had the effect of inducing the Government to abandon the idea of providing such facilities to shipbuilders for securing foreign orders. This step has aroused a strong feeling amongst shipbuilders, who affirm that it is only by the free importation of machinery that they can hope to obtain any relief. They argue that they will secure no advantage from the privilege of being able to import ship-plates free of duty, as the French plate mills are so much in need of work that they are at present offering to deliver supplies at the shipyards at below the English prices, irrespective of import duty. Under the circumstances shipbuilders declare that they are looking to the future with some alarm, and insist that something should be done to enable them to compete for foreign orders.

Commercial Aviation.

A somewhat elaborate plan has been prepared for the organisation of a commercial air service in this country, but its execution is being delayed as much by the high cost of carrying it out as by the fear that the public is not yet disposed to make sufficient use of such a service. The first thing to be done is to educate the public to an appreciation of the safety and economy of air services whenever the time factor is an important consideration. The success of the scheme depends so much upon the connecting up of the different district services that, if done at all, it must be carried out as a whole, and that would require funds which it is impossible to procure at the moment. Moreover, it is found that the services can only be made profitable by the employment of all-metal aeroplanes. It is claimed that with the Loth cable, and the perfect system of signalling now possible, the services can be made quite safe. No really satisfactory precautions, however, seem to have been taken against the danger of high-tension cables which are being laid all over the country. While the national air service scheme is still more or less in abeyance, good progress is being made with the international lines, and a new type of seaplane of huge dimensions is being built at the Chantiers de Penhouët. Money has also been voted for starting a line between Marseilles and Indo-China.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

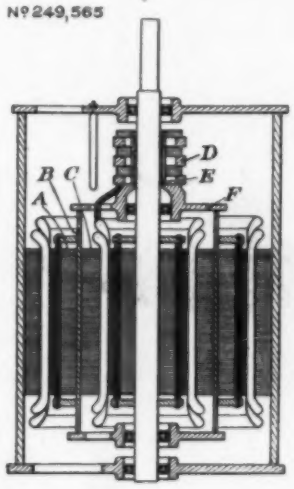
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

249,565. March 22nd, 1926.—IMPROVEMENTS IN ALTERNATING-CURRENT MOTORS, Himmelwerk Akt.-Ges., of Tübingen, Wurttemberg, Germany.

The rotor A of an outer motor is forced on to the casing B of the rotating stator C of an inner motor, and is thereby rigidly connected with the latter. Slip rings D are provided on a hub

Nº 249,565



E, which is formed integral with the rotating bearing bracket F, and pick up current from a network supplying the stator of the outer motor by means of brushes, not shown in the drawing. The casing B consists of an upright steel cylinder and is adapted to contain the stator laminæ, whilst its rear end serves for centring a bearing bracket of the rotating stator C and its stator laminæ.—*January 20th*, 1927.

TRANSMISSION OF POWER.

264,105. October 2nd, 1926.—MILL BEARINGS, *L. Mellersh-Jackson*, 28, *Southampton-buildings, Chancery-lane, London, W.C.* 2.

This invention is concerned with the cooling of bearings, such as those of rolling mills, which are subject to heavy pressures in

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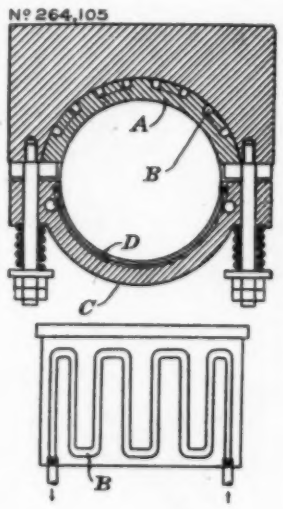
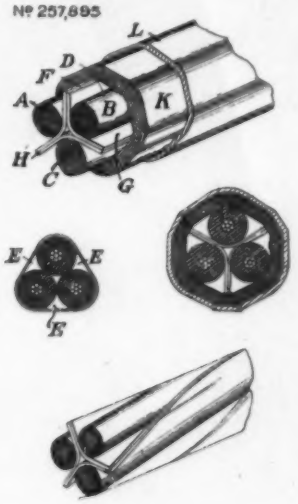


one direction only. The bearing itself A is consequently provided with a series of passages B, through which water is circulated, while the journal is covered by a cap C, with a hollow space D, through which also water is circulated.—*January 13th*, 1927.

257,895. July 7th, 1926.—IMPROVEMENTS IN OR RELATING TO MULTI-CORE HIGH-TENSION ELECTRIC CABLES, Pirelli and Co., of Bicoca Works, near Milan, Italy.

A cable constructed in accordance with this invention is shown in the accompanying drawing, where A, B and C indicate three separate conductors or cores, each of which is covered with a tightly wound body of insulation D, such as paper, which is impregnated with oil. The cores are spaced 120 deg. apart, and are spirally arranged after the fashion of hemp rope, as shown in the lower illustration. The pitch of the spiral depends upon the size of the cores and their insulations. A pitch of from 2ft. to 4ft. will be suitable for most cases. Surrounding the cores is a wrapping or covering of insulation and outside of that a lead sheath. If the three cores are assembled in triangular form, with their insulating coverings in engagement, and with an outside wrapping—as shown in the middle left-hand drawing—it will be evident that with cores of any given size the cross section of the cable will be a minimum, and that there will be small passages E through which oil can flow. This arrangement, while having the smallest cross section for cores of a given size, is defective, however, for a high-tension cable for two principal reasons, namely, that the passages for the oil are much too small and the cable as a whole is not adapted to be drawn into manholes and underground conduits on account of its shape. To provide oil passages of the proper size and also to avoid the objectionable triangular shape for the cable, three separate barriers or separators F, G and H are provided and arranged as best shown in the upper drawing. These barriers, which are made of impregnated paper, are arranged back to back, and extend the whole length of the cable, and are of such width that when bent to the shape shown they will fit within a circle which is tangent to the coverings of the three cores. In addition to forming oil passages, these barriers increase the dielectric strength between two cores. It is to be noted that each barrier is so

Nº 257,895



arranged that it separates one conductor or core from the other two. The barriers are relatively thin and need only be of such thickness as to make them of sufficient mechanical strength to support a spirally wound wrapping or covering of impregnated paper K, which surrounds their outer ends. The fact that the barriers are spirally arranged—coming as they do between spirally arranged cores—means that the paper K can be wound tightly over their longitudinal edges without crushing them. This is important because it preserves the contour of the finished cable. Furthermore, the cable can be bent as required without injury to the barriers or creating an obstruction in the oil passages. Surrounding the paper wrapping is a lead sheath L, which is made fluid-tight as are the joints, so as to retain the oil in the passages within the cable.—*January 20th*, 1927.

FURNACES.

264,411. August 27th, 1926.—RABBLE ARMS, E. Bracq, Achicourt les Arras, Pas de Calais, France.

The rabble arms of pyrites furnaces are, says the inventor, sometimes difficult to extract, when, after long use and by reason of successive contractions or expansions the sockets strongly adhere to their housings in the central spindles. He consequently provides a special fitting for their extraction. The arm A is fitted in a housing in the central spindle B, with a conical

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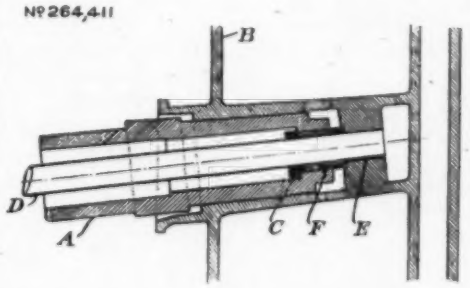

joint and is held in place by a flange C on the cooling pipe D. This pipe is screwed into the housing at E. When it is desired to remove the rabble the pipe D is first withdrawn and then a long hexagon bar is threaded up the arm to engage with the hexagon nipple F, which is screwed externally with a left-hand thread into the end of the arm. This nipple is screwed out, by means of the bar, and, by pressing against the housing dislodges the rabble arm.—*January 20th*, 1927.

MISCELLANEOUS.

259,565. October 2nd, 1926.—IMPROVEMENTS IN OR RELATING TO A DEVICE FOR RECTIFYING ALTERNATING CURRENT, N. V. Philips' Gloeilampenfabrieken, of 6, Eindhoven, Holland.

With rectifying apparatus for high tensions, *e.g.*, 80 volts, and

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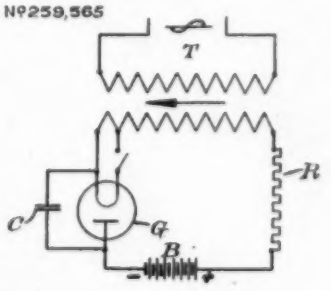
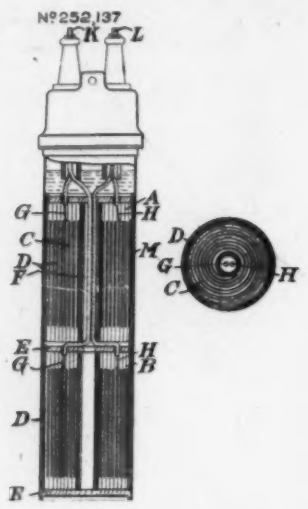


upwards, it is known that when the transformer is switched off on its primary side in consequence of the induction shock produced, a discharge takes place in the tube in the wrong direction, and consequently an electron current flows from the anode

to the cathode, which may be result in the battery being discharged. The diagram shows a rectifying installation comprising one discharge tube so that one half of the alternating-current wave is rectified. T is a transformer, R a resistance, C a capacity, G a rectifying tube, and B a battery, which has to be charged. In the ordinary way, when the transformer is switched off an induction stock is produced in the direction indicated by the arrow and the battery would be discharged. In accordance with the invention, however, the current shock is received by the condenser and a return shock in the discharge tube is prevented. —*January 20th*, 1927.

252,137. April 21st, 1926.—IMPROVEMENTS IN AND GENERAL ARRANGEMENT OF ELECTRIC CONDENSERS, Max Sieverts Fabriks Aktiebolag, of Sundbyberg, near Stockholm, Sweden.

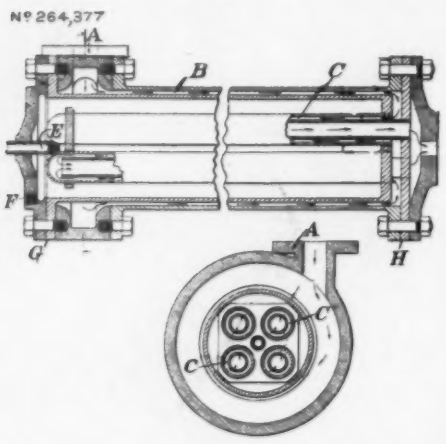
This specification describes a condenser, suitable for power factor correction, which may deal with a heavy load without overheating. A and B are two condenser units, manufactured by forming in the shape of a roller, two metallic foils C, with insulating interlayers D. These condenser units are placed one over the other and rest on suitable supports—for instance, wooden



discs E. The longitudinal axes of the condenser cylinders have a longitudinal channel F for receiving the connecting conductors G and H, each connected to a layer C in the condenser unit, and extended to the points of contact K and L at the ends of the insulators, which are attached to the cover of the cylinder M constructed of sheet metal and tightly enclosing the condenser units; that is to say, making contact directly with the external insulating layer D of the units. The cylinder M is filled with a quantity of oil, so that the condenser units are entirely below the top surface of the oil.—*January 20th*, 1927.

264,377. May 17th, 1926.—FUEL OIL HEATERS, G. U. Morgan, 109, Kingsway, London, W.C. 2.

The object of this invention is to provide an oil heater which can be easily and quickly dismantled for cleaning. Its construction can best be explained by following the paths of the oil and the heating steam. The oil enters at A and flows to the



right through the annular space B. It then goes up the annular spaces C C of the internal tubes, returns by the central tubes and is discharged. The steam is supplied at E and the condensate is drained away at F. It will be seen that by breaking the two joints at G and H the whole of the heating surfaces exposed to the oil are readily accessible for cleaning.—*January 20th*, 1927.

245,753. December 21st, 1925.—METHOD OF INCREASING THE OHMIC RESISTANCE OF PURE IRON, ESPECIALLY ELECTROLYTIC IRON, Siemens and Halske Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

This specification described improvements in methods of increasing the ohmic resistance in pure iron, especially electrolytic iron. The surfaces of pure iron bodies of any size or form are furnished with a layer of silicon by leading a current of hydrogenated silicon (SiH_4) over the iron at a raised temperature—for example, 600 deg. to 700 deg. Cent. The hydrogenated silicon necessary for the process may, for instance, be obtained after the known method of Stock. Through the decomposition of the hydrogenated silicon, which takes place when it comes into contact with the metal, silicon will deposit on the surface of the iron and the silicon will diffuse into the surface of the iron when the temperature is raised anew at a second stage of the process, so that silicated iron is formed. In order to obtain a uniform distribution of the silicon and simultaneously to remove the hydrogen completely the subjecting to a higher temperature should be carried out in high vacuum. For this purpose the body provided with the coating of silicon is placed in a highly evacuated chamber; for example, a tube of fireproof material closed on all sides in which it is heated to the temperature required. In practice the method may, for instance, be carried out after the following example:—The object to be treated, for instance, a dynamo plate, is brought into a tube of refractory material and a current of hydrogen is conducted through the tube in order to remove the air. When the air has been removed completely the tube is heated to a temperature of 600 deg. to 700 deg. Cent. As soon as the interior of the tube and the dynamo sheet in it have reached this temperature, hydrogenated silicon (SiH_4) is admitted into the tube, in which a portion of the substance will dissociate into silicon and hydrogen. This silicon will deposit on the sheet under treatment in the form of a shining, firmly adhering, even layer. In order to establish an intimate connection between silicon and the sheet the current of hydrogenated silicon (SiH_4) is stopped, whereupon the temperature is raised to 1000 deg. Cent. and a current of hydrogen is passed through the tube. This last stage of the process lasts commonly for about fifteen minutes. If it is desired to obtain an extremely great change in the ohmic resistance of the material to be treated, the process may be repeated one or several times. By means of the new method it becomes possible to utilise electrolytic iron directly for electro-technical purposes.—*January 27th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

BRITISH INDUSTRIES FAIR.—Castle Bromwich, Birmingham, and White City, London. 10 a.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Cinematograph Exhibition. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Informal meeting. "An Evening with the Old Brigade." 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Some Colouring Agents in Glasses and Glazes," by Sir Herbert Jackson. 9 p.m.

SATURDAY, MARCH 5TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Champness Hall, Drake-street, Rochdale. Lecture. "The Foundry Cupola," by Mr. W. H. Poole. 6.30 p.m.

LONDON ASSOCIATION OF FOREMEN ENGINEERS.—Cannon-street Hotel, London, E.C. 4. Seventy-fourth anniversary festival. 6 p.m.

MONDAY, MARCH 7TH.

BRADFORD ENGINEERING SOCIETY.—The Technical College, Bradford. Lecture. "Some Mechanisms of Textile Machinery," by Mr. W. A. Hanton. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: WESTERN CENTRE.—Merchant Venturers' Technical College, Bristol. Paper, "Some Notes on Petrol Engine Development," by Mr. H. R. Ricardo. 6.45 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. General meeting. 5 p.m.

SOCIETY OF ENGINEERS.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "The Raising of a 1250-ton Coal Bunker after a 7ft. Subsidence," by Mr. M. E. Gerrard. 5.30 p.m.

SURVEYORS' INSTITUTION.—12, Great George-street, London, S.W. 1. Discussion on "Leasehold Reform." 8 p.m.

TUESDAY, MARCH 8TH.

INSTITUTE OF MARINE ENGINEERS.—85–88, The Minories, Tower Hill, London, E. 1. Paper, "The M.A.N. Internal Combustion Engine and other Types," by Mr. W. F. Rabbidge. 6.30 p.m.

INSTITUTION OF AERONAUTICAL ENGINEERS.—Junior Institution of Engineers, 39, Victoria-street, London, S.W. 1. Paper, "Portable Hangars," by Major H. N. Wylie. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: COVENTRY CENTRE.—Broadgate Café, Coventry. Paper, "Nitro-cellulose Enamels," by Mr. W. Fletcher-Starkey. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Paper, "The Tansa Completion Works for the Water Supply of Bombay," by Mr. A. W. Stonebridge. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Hotel, Edinburgh. Paper, "High-power Fusible Cut-outs," by Mr. L. C. Grant. 7 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Two Shallow Oilfields in Texas," by Dr. Arthur Wade. 5.30 p.m.

INSTITUTION OF PROFESSIONAL CIVIL SERVANTS.—Lecture Hall of the Surveyors' Institution, 12, Great George-street, London, S.W. 1. Lecture, "The Development of Airship Transport," by Major G. H. Scott. 5.30 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Queen's Chambers, John Dalton-street, Manchester. Paper, "Storage Battery Locomotives in Mine Service," by Mr. A. W. Browne. 4 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: MIDDLESBROUGH BRANCH.—Cleveland Scientific and Technical Institution, Corporation-road, Middlesbrough. Paper, "From Ironstone to Finished Product," by Mr. G. B. Butler. 7.30 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. Paper, "Cold-rolled Steel," by Mr. G. R. Bolsover. 7.30 p.m.

WEDNESDAY, MARCH 9TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Informal meeting. Discussion on "Traverse Surveys," introduced by Mr. A. H. Douglas. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—The University, Edmund-street, Birmingham. Papers: "Illuminating Engineering," by Mr. J. W. T. Walsh; and "The Problems of Public Lighting by Electricity," by Lieut.-Commander H. T. Harrison. 7 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. Graduate Section meeting. "Grinding," by Mr. J. H. Frith. 7.15 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "The Utilisation of Gas Coke," by Dr. E. W. Smith, 8 p.m.

WEDNESDAY AND THURSDAY, MARCH 9TH AND 10TH.

INSTITUTE OF METALS.—Institution of Mechanical Engineers, Storey's-gate, London, S.W. 1. Annual general meeting. For programme see page 184. 10 a.m. each day.

INSTITUTION OF CHEMICAL ENGINEERS.—Burlington House, Piccadilly, London, W. 1. Conference. For programme see page 193.

THURSDAY, MARCH 10TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Cavendish Café, Cornmarket, Derby. Derby Graduates' meeting. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH.—Hotel Metropole, Leeds. Lecture, "Deep Well Boring and Pumping Plant," by Mr. J. E. Hills. 7.30 p.m.

FRIDAY, MARCH 11TH.

DIESEL ENGINE USERS ASSOCIATION.—Caxton Hall, Westminster, London, S.W. 1. Paper, "High-Revolution Oil Engines," by Mr. P. A. Holliday. 3 p.m.

EX-BRITISH WESTINGHOUSE ASSOCIATION.—Hotel Cecil, Strand, London, W.C. 2. Ninth re-union dinner. 5.45 for 6.45 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Applied Science Department of the University, St. George's-square, Sheffield. "Old-fired Furnaces," by Mr. I. Lubbock. 7.30 p.m.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—Metallurgical Department of the University College, Singleton Park, Swansea. "The Influence of Oxygen on Copper and other Non-ferrous Metals," by Dr. F. Johnson. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Liverpool Engineering Society's Rooms, The Temple, Dale-street, Liverpool. Paper, "Ships' Lifeboat Motors," by Mr. A. F. Evans. 7 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: LONDON STUDENTS' SECTION.—Savoy-place, Victoria Embankment, London, W.C. 2. Joint meeting with the Students' Sections of the Institutions of Civil and Mechanical Engineers. Lecture, "Patents," by Mr. A. C. Price. 6.15 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, Westminster. "The Development of Mechanical Vehicles for General Load-carrying Duty in the Army," by Captain C. H. Kuhne, D.S.O. 5.15 p.m. (change of hour).

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "The Wall of Hadrian," by Sir George Macdonald. 9 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Indian Section meeting. "The Iron and Steel Industry in India," by Mr. R. Mather. 4.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Cupolas," by Mr. J. Wolstenholme. 7.30 p.m.

SATURDAY, MARCH 12TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Western District meeting at Bath. 12 noon.

MONDAY, MARCH 14TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Annual general meeting. "Moulding Sands," by Mr. G. Watt Tyrrell. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Chamber of Commerce, New-street, Birmingham. Joint meeting of the Birmingham and Wolverhampton Centres. Paper, "The High-tension Magneto, with Especial Reference to its Design, Manufacture and Service," by Messrs. A. P. Young and L. Griffiths. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—The College, Loughborough. Loughborough Graduates' meeting. Paper. "Modern Motor Cycle Engines," by Mr. C. Legge. 7 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Cantor Lecture, "Some Industrial Applications of Electrothermics," by Mr. G. I. Finch. 8 p.m.

TUESDAY, MARCH 15TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, BURNLEY SECTION.—Municipal College, Ormerod-road, Burnley. Lecture, "The Mixing of Cast Iron, with Special Reference to Carbon, Silicon, Phosphorus, Manganese and Sulphur," by Mr. A. Buck. 7.15 p.m.

WEDNESDAY, MARCH 16TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Students' meeting. Paper, "Fire Protection in Buildings, with special reference to Reinforced Concrete Construction and Automatic Sprinklers," by Mr. F. C. Jordan. 6.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND CENTRE.—The University, Edmund-street, Birmingham. Wireless Sub-section meeting. Lecture, "Characteristics of Audio-frequency Amplifiers Used in Telephonic Repeaters," by Mr. C. Robinson. 7 p.m.

THURSDAY, MARCH 17TH.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—Society of Motor Manufacturers and Traders' Rooms, 83, Pall Mall, London, S.W. 1. "The Works Chemist," by Mr. C. E. Barrs. 7.30 p.m.

FRIDAY, MARCH 18TH.

FARADAY HOUSE OLD STUDENTS' ASSOCIATION.—Bush House Restaurant, Aldwych, London, W.C. 2. Dance. 8 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: LONDON STUDENTS' SECTION.—Imperial Hotel, Russell-square, London, W.C. 1. Annual dinner. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "An Investigation of Torsional Vibration, with particular reference to Aircraft Engines," by Mr. J. Calderwood. 7.30 p.m.

ELECTRODEPOSITION OF IRON.—At the fourteenth meeting of the Electroplaters and Depositors Technical Society, held on Wednesday, 23rd ult., at the Northampton Polytechnic Institute, a paper on "The Electrodeposition of Iron" was read by Mr. T. Johnston. Mr. Johnston prefaced his paper with a *résumé* of the history of iron deposition, and showed that progressive improvements had brought up the employable C.D. from 2 to as high as 240 ampères per square foot. There were many difficulties met with in the process, owing to the chemical and electro-chemical peculiarities of iron. The depositing solutions commonly used were based on the simple sulphate and chloride solutions, or a mixture of them, three characteristic baths being the Fischer-Langbein (chloride) solution, the Burgess-Hambuechen (sulphate) solution, and the Watts-Li (sulphate-chloride) solution. In all cases it was best to use fairly high temperatures, and comparatively high current densities could be employed. Iron baths were very sensitive to slight variations in conditions, one of the most important factors being the degree of acidity of the bath. The purity of electrolytic iron might reach 99·96–99·99 per cent. Hydrogen which was occluded in large quantities was difficult to eliminate, but it was possible to remove it by suitable heat treatment. The metal was then highly ductile and was particularly suitable for cold working, stamping, &c. Among the most interesting applications were the following:—The "steel facing" of printing blocks; "building up" worn and undersized parts; production of finely divided magnetic material; manufacture of tubes, sheets and strip; preparation of "pure" iron for research, &c.